AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 11, No. 10. WEEKLY. | NEW YORK, MARCH 10, 1888. | $2.50 per Annum. SINGLE COPIES 5 CENTS.

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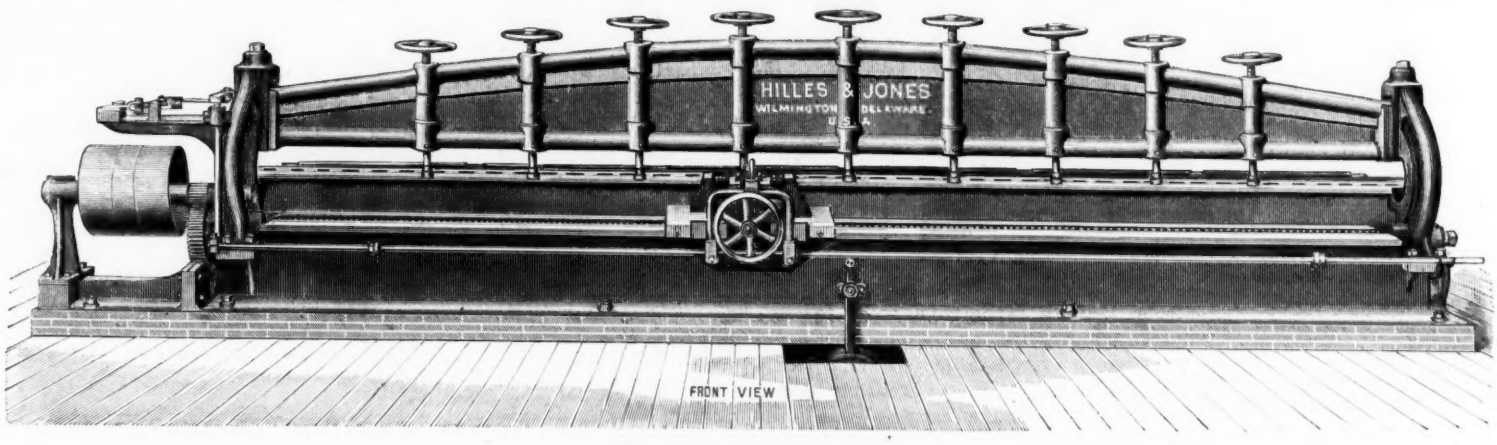
New Plate Planing Machine.

Among the machines recently designed and brought out by Hilles & Jones, of Wilmington, Delaware, is a line of improved boiler plate planers, of which the accompanying illustration is a front view.



NEW PLATE PLANING MACHINE.

In this machine the tool carriage or saddle is driven by means of a steel screw, which is supported its entire length lying in a groove, which keeps it always thoroughly oiled and prevents it from being sprung.

The screw is powerfully geared, giving ample driving power for taking a heavy chip from a thick plate of iron or steel. There are two separate tools on the tool post, and they are so arranged on the saddle as to admit of easy and independent adjustment, and the cut is taken both ways, the same movement that shifts the belts in reversing moving the tool automatically into position to take the return cut. This belt-shifting arrangement is such that a very short movement of the saddle can be had when desired.

The machines are so designed that the large table holds the plate, and at the same time answers as a gauge for quickly setting the edge of the plate, so that no time need be spent in measuring with a rule. The screws in the cross-bridge are for straightening and taking the buckles out of the edge of the plate, and at the same time they hold it securely while being planed.

The large sized machine weighs 23,000 pounds, and will plane 18 feet at each setting, or any length by re-setting the plate. They are also made so that the beam clamps the plate instead of the screws, when so ordered.

Some time since we noted an enormous magnet constructed by Major King, at Willett's Point. The magnet was made by winding about eight miles of submarine cable around two 15 inch Dahlgren guns. This magnet does such work as to hold suspended a string of several 15 inch solid shot. It was thought that it afforded a good opportunity to test the quality of American non-magnetic watches which railroad corporations are compelling engineers and other employes to use. An ordinary watch brought within three feet of this magnet immediately suspended operations. An American non-magnetic watch brought close to the magnet and held there for ten minutes was said not to have been in the least affected.

"The Niagara" 26-in. Endless Bed Double or Single Surfacer.

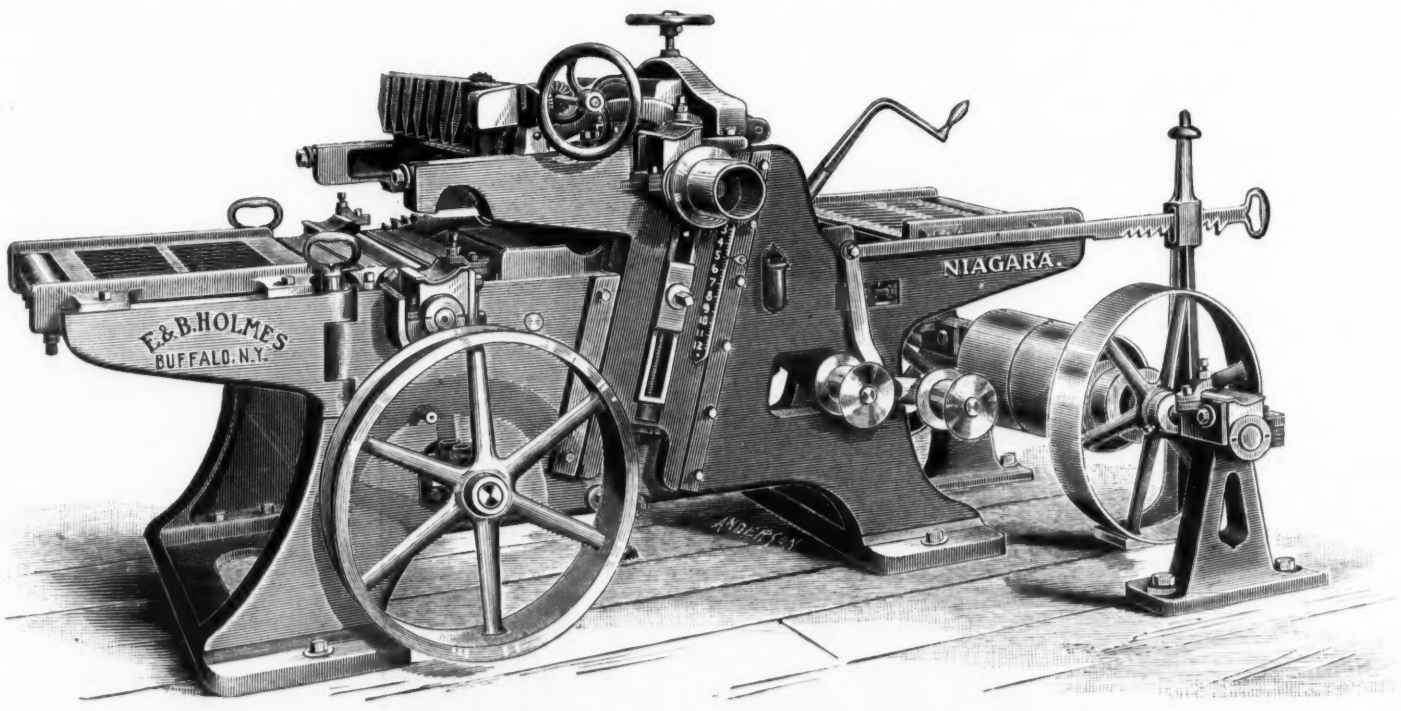
The accompanying illustrations, pages 1 and 2, show the general design and some of the details of construction of a new "endless bed" surfacing machine, containing some new features by which the makers claim to have done away with many of the objectionable ones of such machines as heretofore constructed.

The detail cut, page 2, shows in elevation and plan, the arrangement of the endless bed, and of the stationary bed over which it passes. It will be noticed the arrangement of the bearing surfaces of the stationary bed is diagonal instead of straight, as is usually the case, whereby a much better distribution of the bearing points is secured, and the "lags" are much better supported, and thereby prevented from yielding under the blow of the knives. By this arrangement it is also claimed that there is much less trouble from accumulation of gum or other substances upon the lags, which sometimes make it difficult to keep the machine planing to a uniform thickness. The roll shown under the bed is covered with sheepskin, with the wool on, and a perforated pipe above supplies it with oil, which comes from an oil pocket at the side of the machine. This roller rests upon the inner surface of the lags, as shown, and distributes over them a thin and uniform film of oil, thereby securing thorough lubrication. The cap is made very heavy, to act as an anvil to absorb the force of the blow of the knives and prevent vibration.

Adjustable pressure rolls are used, which permit the planing of two boards of unequal thickness at the same time. They are hung on an eccentric shaft, which is made of a steel forging; the rolls revolve on this shaft, and the shaft swings in boxes at each end, and thus accommodates itself to any irregularity in the thickness of the lumber being planed, thus doing away with the necessity for the old-fashioned broken roll with its small center bearings.

The pressure plate that holds the board to the under cylinder is provided with diagonal ribs, which prevent the creasing of the lumber, and sweep off everything that approaches them, leaving the lumber free from indentations, which are so annoying to the operator.

Instead of raising or lowering the bed the head is adjusted for the desired thickness,



ENDLESS BED DOUBLE OR SINGLE SURFACER.

a feature which the builders state is a decided advantage, especially when planing very long or heavy stuff. The machine will plane 12 inches thick and 26 inches wide, one or both sides, and can be made any desired width. The heads are four-winged, are solid steel forgings, and all shafts and studs are of steel. The best grade of babbitt is used throughout. The tight and loose pulleys are 14 inches diameter, 8½ inches face, and should make 850 revolutions per minute. Weight of machine, about 6,000 pounds.

The manufacturers are E. & B. Holmes, Buffalo, N. Y.

Compound Engines.

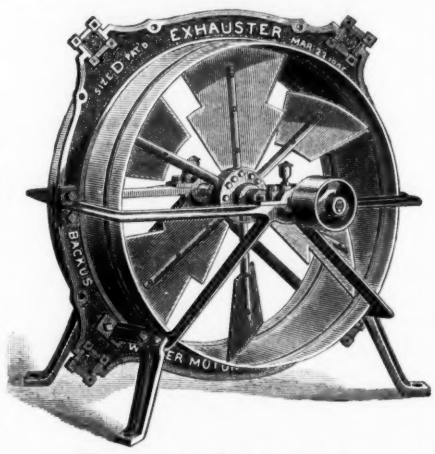
By W. H. Booth.

SECOND PAPER.

The chief cause of loss in the steam engine is cylinder condensation. Now this is due to the variation in temperature which occurs in the cylinder. In a simple engine working with steam of an initial temperature of 300°, and a condenser temperature of 150°, there is a temperature range of 150° in one cylinder. What now does this teach us?

The inner skin or surface of the cylinder and piston absorb and restore heat very rapidly indeed. Assuming the cylinder heated up to that of the initial steam, or 300°, then, as the piston makes its stroke, the steam expands and falls in temperature, and the inner surface of the cylinder and piston falls correspondingly, so that at the termination of the stroke the metallic surface is cooled down to 150°. When next steam is admitted, it is at once condensed upon the internal cooled surfaces, and continues to condense until the surface attains steam temperature. The water formed by this condensation is re-evaporated as expansion proceeds, and gives back something of the heat absorbed by the cylinder from the fresh incoming steam, but the final result is a loss, for the evaporation cools down the cylinder, which is thus again in excellent condition to act as a condenser to the next supply of boiler steam, but in very poor order indeed for doing duty as a steam cylinder. Now by the compound system the range of temperature in each cylinder is only one-half of 150°, or 75°, and as the high pressure cylinder is only a third or a half the weight of the low, and the range of temperature also is reduced a half, the probability of condensation is only about a sixth in the small cylinder, and a half in the large cylinder, or a total condensation of about two-thirds that of the simple engine. Further, any steam which condenses in the first cylinder, and re-evaporates at the latter half of the stroke, passes, not to the condenser, but, as in the case of leakage already named, it is intercepted by the low pressure cylinder, and exercises pressure therein throughout its whole stroke, serving to raise the mean pressure in this cylinder. This "heat trap" theory, as it has been jocularly termed, is nevertheless good and correct, and it is by reduction of temperature range, perhaps, more than by any other cause, that compound engines get an advantage over the simple type. Generally, then, it will be seen, that the economy of the compound engine depends upon the effects resulting from the smallness of the cylinder into which the high pressure hot steam is first admitted and expanded; for, as we have seen, the area for leakage is less, the surface for radiation from hot steam is less, and the temperature ranges are less also.

In our first paper we laid special stress upon the term "well-designed," and we may now well consider how all the benefits accruing from the compound principle may be entirely wasted, and worse than wasted, by improper design, bad proportion of cylinders and bad steam distribution. Take, as an example, the favorite French method of working, as exemplified in the Woolf engine. The Woolf engine is, after all, only an ordinary compound engine, but the French method of working such engines is to have a quite small high pressure cylinder. Thus for six expansions the small cylinder would have a volume one-sixth only of the large cylinder, and steam would be carried on for the full stroke of this first cylinder, and then exhaust into the large cylinder, wherein also it would be carried without cut-off throughout the stroke. Now, nothing can be more wasteful than such a practice. In the first place, by carrying steam for the full high pressure stroke, they make the initial pressure in the second cylinder equal to the initial pressure in the first cylinder, and thus lose the advantage which is gained by reducing the range of temperature in each cylinder; for in the first



Ventilating Exhaust Fan.

cylinder there is no range, and in the second the full range from boiler to condenser temperature, and all cylinder condensation, or a very large proportion, indeed, much larger than in correct working, takes place in the second cylinder only, and the gain from utilizing the steam formed by re-evaporation in the small cylinder of the water formed by initial condensation is not secured.

This system of compound working is, in fact, merely the simple system with the complication of an extra cylinder, without its advantages, not excepting even those connected with reduction of crank-pin pressures, and general working stresses on the moving parts. Considering further the French method of working the admission of steam throughout the full stroke of the low pressure cylinder, it should be clear to engineers who practice this system, that there is no more reason in it than in carrying steam in a simple engine cylinder throughout full stroke, and throttling instead of cutting-off and working expansively. To remedy the faults of a Woolf engine, or of a compound engine worked on the Woolf system, is easy in some cases.

New Ventilating Exhaust Fan.

The accompanying cut represents a new fan for exhausting air from rooms, shops, factories, etc., for ventilation, circulation of heated air, or other purposes. It will be noticed that there are two forms of blades used in combination, and the makers state that by experimenting they have ascertained that by this means they avoid back currents at the center, or "back lash," as it is sometimes called.

As shown in the cut, the fan is intended to stand upon a floor or other support, but if it is desired to place it in a side wall, it is only necessary to remove the legs which are bolted to the frame, make a circular opening through the wall large enough to let the outer rim enter, and fasten the fan in place by screws or bolts passed through holes made for the purpose in the flange.

The boxes and shaft are so arranged that the shaft and fan may be taken out and reversed "end for end" when for any reason it is desired to do so; thus the belt may go on at either side, or the fan may work either way.

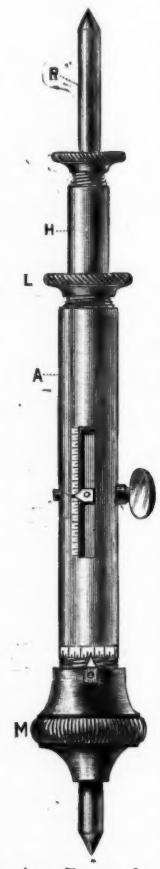
They are being put into public buildings for ventilating, and into shops and factories where dust caused by grinding and polishing operations, or where steam or noxious vapors of any kind, resulting from manufacturing operations, are to be removed, and we are informed are giving excellent satisfaction in such service.

The outer rims and the blades are made of sheet steel.

They are manufactured in sizes ranging from 12 to 120 inches by the Backus Water Motor Company, Newark, N. J.

Tickell's Inside Micrometer Gauge.

The accompanying illustration shows a gauge intended for inside measurements invented by Mr. John Tickell, of Cleveland, Ohio. As will be seen, it embodies the micrometer principle by means of the milled nut *M* and the circular graduated scale and pointer, which reads to thousandths of inches. The tube *H* slides inside of tube *A*, and can be tightened in any desired position by the milled nut *L*. The tube *H* has a pointer made fast to it, which comes through the slot in *A*, and by means of the straight scale indicates its movement.



The taper pin shown passing through both tubes is used for gauging holes or recesses, where, from the nature of the case, the gauge must be reduced in length to get it out after being set. There is one hole through the outside tube for this pin and three through the inner tube *H*, which are some distance apart to provide for different extensions of the gauge. When the gauge with this pin inserted is passed into a recess or chambered hole, and set to the desired size, the pin is withdrawn and the tube *H* pushed in sufficient to enable the gauge to be withdrawn; when, the pin being reinserted, the gauge is restored to size, and any desired allowance for shrinkage fits, etc., can be made by the micrometer nut.

The stem *R* also slides in or out to suit different sized work, and can be tightened at any desired point by the upper milled nut.

The contact points are hardened to prevent wear, and the gauges are to be made in various sizes, ranging from two to forty inches.

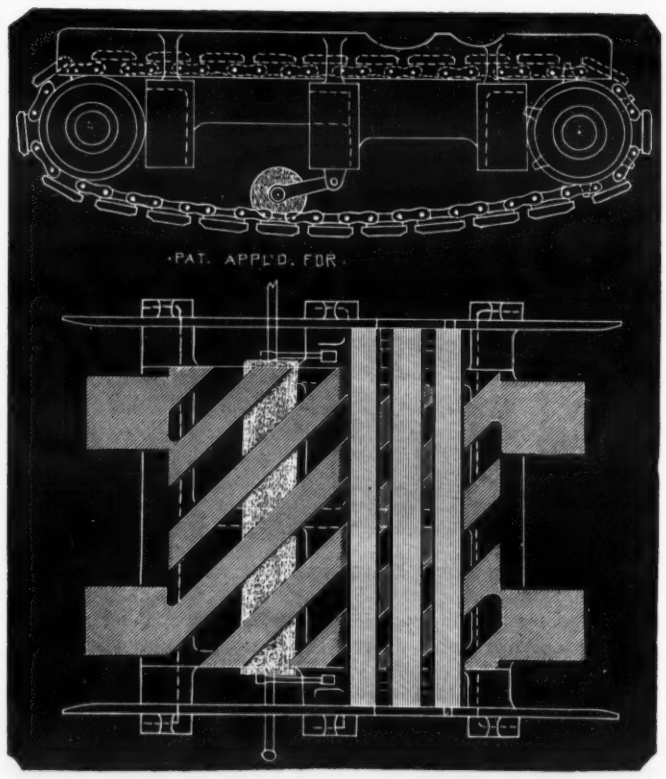
George H. Corliss.

George H. Corliss died at his residence at Providence, R. I., on Feb. 21, of paralysis of the heart. Mr. Corliss was born in Easton, N. Y., in 1817. Although not educated for mechanical pursuits, he early showed signs of the ability in that direction which later made him famous throughout the civilized world. He will always be chiefly known for his efforts in perfecting the steam engine, towards which he unquestionably did more than any individual of his generation. Not only have his designs been extensively copied in this country, but in every country in the world where steam is used. He was honored even more abroad than at home, having been awarded the Rumford medal, and various diplomas, prizes and awards from foreign countries. In 1886 the King of Belgium made him an officer of the Order of Leopold. George H. Corliss will always be known as one of the great engineers of the world.

According to *Engineering*, some recent investigations of the subject of belt capacity, by Mr. Otto Gehrkens, of Hamburg, indicate that the strain per inch of width may be 55 pounds at high speeds, such as 2,000 feet per minute, but at slower belt speeds the strain should be reduced to 40 pounds.

A wrench, recently patented in England, consists of a circular head provided with jaws of different sizes. This head can be revolved on the handle, and held in the position desired by means of a bolt head engaging with one of the jaws.

W. Doxford & Sons, at Sunderland, England, have brought out a machine for planing the blades of propeller wheels. It works on a sort of pantograph principle, a former of the proper shape guiding the cutting tool, through suitably arranged levers.



Endless Bed Surfacer.—See Page 1.

Practical Drawing.

By J. G. A. Meyer.

FORTY-FIFTH PAPER.

Problem 58.

410. To find the lines in which a prism passed through a cylinder will intersect the cylindrical surface—development of cylindrical surfaces.

Figs. 298, 299. Let *a b c d* be the vertical and $a_2\ c_2\ e_2\ g_2$ the horizontal projection of the cylinder whose axis is parallel to the vertical and perpendicular to the horizontal plane of projection; also let *h i j k* be the ver-

tical, and $h_2\ i_2\ m_2\ n_2$ be the horizontal projection of a prism passed through the cylinder; the face $h\ i\ j\ k$ of the prism is parallel to the vertical plane of projection. It is required to find the lines $o\ p$ and $o_3\ p_3$ in which the prism will cut the cylindrical surface.

The lines $h\ i$ and $j\ k$ in Fig 298 are represented in Fig. 299 by only one line $h_2\ i_2$, because, since the face $h\ i\ j\ k$ of the prism is parallel to the vertical plane of projection, the lines $h\ i$ and $j\ k$ must lie in one and the same projecting plane, and since the trace of the projecting plane is the projection of the line, or lines, which the plane contains (Art. 236), it follows that the lines $h\ i$ and $j\ k$ can only be represented in Fig. 299 by one line $h_2\ i_2$. Therefore, the line $h\ i$ is the vertical, and the line $h_2\ i_2$ the horizontal projection of the edge $(h\ i,\ h_2\ i_2)$;* the line $j\ k$ is the vertical, and the line $h_2\ i_2$ the horizontal projection of that edge, which, in Fig. 299, is hidden by the edge $(h\ i,\ h_2\ i_2)$.

In Fig. 298 there are only two lines that can be seen, and which must be found, in which the prism cuts the cylinder, and these are the two lines $o\ p$ and $o_3\ p_3$, in which the face $h\ i\ j\ k$ of the prism intersects the surface of the cylinder. True, there are besides the lines $o\ p$ and $o_3\ p_3$ in Fig. 298—other lines in which the prism cuts the cylinder, but these lines coincide with and are hidden by the edges of the prism, and consequently a construction for finding these lines is not required. For instance, the prism will cut the cylinder in lines coinciding with and hidden by the parts $a_3\ o$, $a_4\ p$, $o_3\ c_3$, and $p_3\ c_4$ of the lines $h\ i$ and $j\ k$, and since the lines $h\ i$ and $j\ k$ are given, the lines coinciding with $a_3\ o$, $a_4\ p$ are also known.

The axis of the cylinder and the face $h\ i\ j\ k$ of the prism are parallel to each other, because, according to the conditions given in the problem, both are parallel to the vertical plane of projection. In Art. 405 we have seen that all cutting planes parallel to the axis will intersect the cylindrical surface in two elements, and therefore, when we consider, as we may do, the face $h\ i\ j\ k$ to be a cutting plane, we know that it must cut the cylindrical surface in two elements $s\ r$ and $s_3\ r_3$, or, more precisely, in two straight lines $o\ p$, $o_3\ p_3$, which are portions of the elements $s\ r$ and $s_3\ r_3$. The points o_2 and o_4, in which the line $h_2\ i_2$ cuts the circumference $a_2\ c_2\ e_2\ g_2$, are points of the elements $s\ r$, and $s_3\ r_3$; therefore, through the points o_2 and o_4 draw the vertical lines $o_2\ s$ and $o_4\ s_3$, cutting the lines $h\ i$ and $j\ k$ in the points o, o_3, and p, p_3 respectively; the lines $o\ p$ and $o_3\ p_3$ will be the lines in which the face $h\ i\ j\ k$ cuts the cylindrical surface.

A practical application of this construction is seen in the cap for a bearing or pillow block shown in Figs. 300 and 301. In this case we may consider the face $h\ i\ j\ k$ of the lug to be the face of a prism, consequently the lines $o\ p$ and $o_3\ p_3$, in which the face of the lug intersects the cylindrical part of the cap, are found by drawing through the points o and o_4 vertical lines cutting the edges $h\ i$, $j\ k$ of the lugs in the points o, p and o_3, p_3 respectively; the lines $o\ p$ and $o_3\ p_3$ will be the lines in which the lugs meet the cylindrical part of the cap.

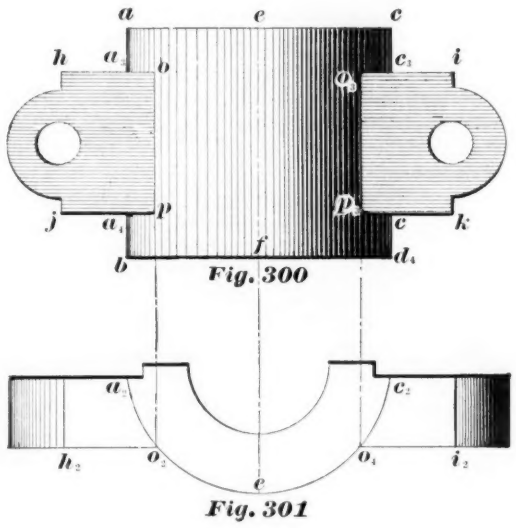


Fig. 300

Fig. 301

Sometimes the ends $a\ a_3\ c\ c_3$ and $a_4\ b\ c\ d$ of the cap are turned down; in such a case we really form parts of three distinct cylinders A B and C, as shown in Fig. 302. In this figure it will be noticed that the bases $a_3\ c_3$, $a_4\ c_4$ which separate the cylinders, are seen, and therefore in our drawing of a cap shown in Figs. 303, 304, in which the parts $a\ a_3\ c\ c_3$ $a_4\ b\ c_4\ d$ are reduced in diameter, a horizontal line is drawn from the point o to the point o_3, also from point p to p_3, to represent the limit of the reduced cylindrical part of the cap.

In Fig. 304 the arc $o_2\ e_2\ o_4$ represents a portion of the base of the large cylindrical part of the cap, and the arc $a_2\ e_3\ c_2$ represents the base of the small cylindrical part of the cap. Comparing Fig. 304 with 301 we find that in the latter figure the whole of the cylindrical part of the cap is represented by only one arc, $a_2\ o_2\ e\ o_4\ c_2$; and this is as it should be, because in this case the diameter of the cylindrical part of the cap is the same throughout.

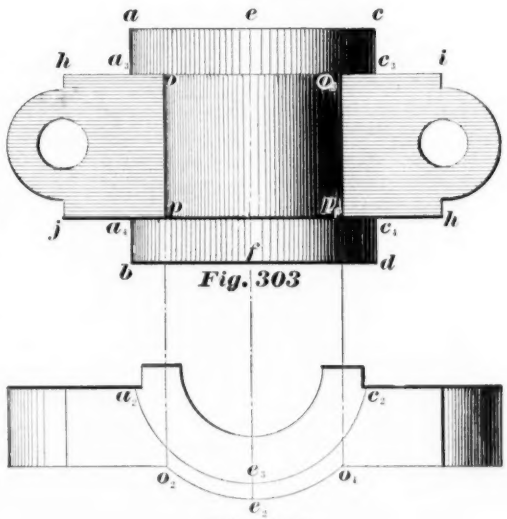


Fig. 303

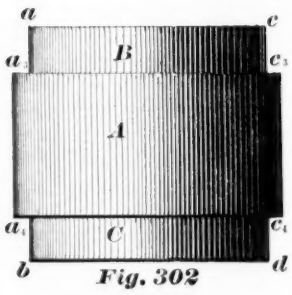


Fig. 302

Fig. 304

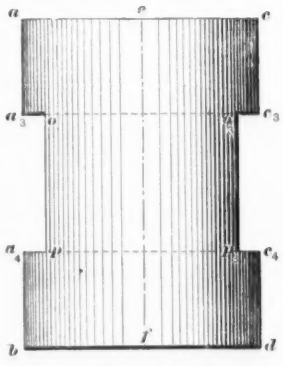


Fig. 305

DEVELOPMENT OF CYLINDRICAL SURFACES.

When a cylinder is placed on a plane surface, say on the drawing board, with its axis parallel to the face of the board, the cylinder will touch the board in a straight line, that is to say, the line of contact between the board and cylinder will be an element of the cylinder. Now, in order to develop the surface of cylinder, we place the cylinder on the surface of the paper, with the axis of the former parallel to the plane of the latter, and mark off the line of contact, which we will call line No. 1. We then roll the cylinder along the face of the paper until it has made one complete revolution, and then again mark off the line of contact, and call it line No. 2. The distance from the line 1 to line 2 will be length of the developed cylindrical surface, and the depth of the cylinder will be breadth of the developed cylindrical surface. The construction shown in Fig. 306 is based upon this principle.

When, in Fig. 298, the prism $h\ i\ j\ k$ is removed, the cylinder will appear as shown in Fig. 305. In this figure, the parts marked $a_3\ o\ a_4\ p$ and $c_3\ o_3\ c_4\ p_3$ represent the openings in the cylindrical surface made by passing through it the prism. It is now required to develop the cylindrical surface $a\ b\ c\ d$, shown in Fig. 305.

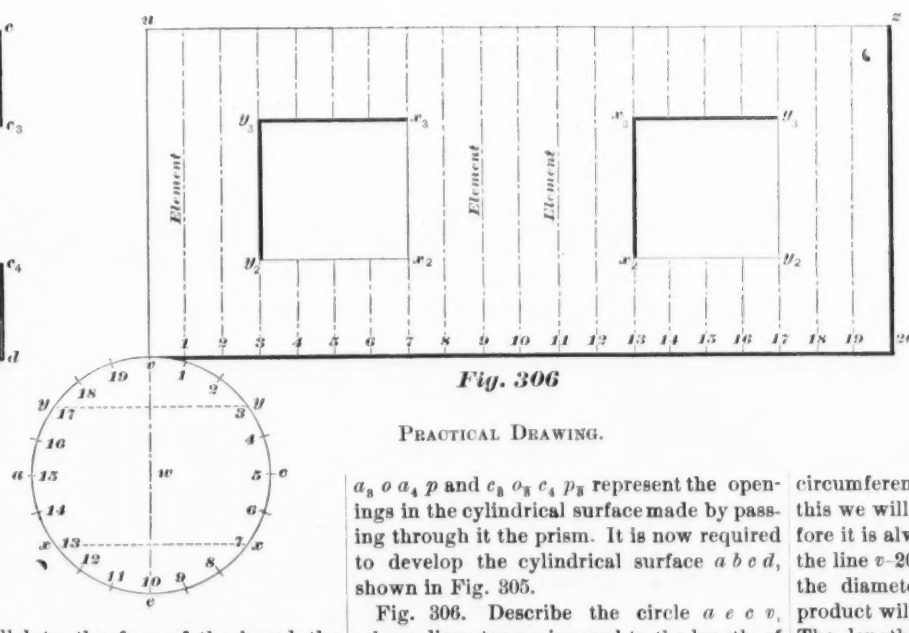


Fig. 306

PRACTICAL DRAWING.

Fig. 306. Describe the circle $a\ e\ c\ v$, whose diameter $a\ c$ is equal to the length of the line $a\ c$ or $b\ d$, in Fig. 305. Through the center w draw the vertical line $e\ u$, cutting the circumference $a\ e\ c\ v$ in the point v. Commencing from this point v, divide the circumference $a\ e\ c\ v$ into any number of equal parts, the more the better, say twenty parts; and mark the points of division 2, 3, 4, etc. Through the point v draw the horizontal line v–20. On this line, commencing at the point v, lay off in succession twenty spaces; each one of these spaces must be equal to one of the spaces on the circumference $a\ e\ c\ v$. Through the point of division marked 20, draw a vertical line 20–z; make the length of this line equal to the depth $e\ f$ (Fig 305) of the cylinder, and through the point z draw the line $z\ u$ parallel to the line v–20. The rectangle $v\ u\ z\ 20$ will be the development of the cylindrical surface. If a piece of paper be cut, its length and breadth equal to the length and breadth of the rectangle, this piece of paper will just cover the cylinder.

Through the points of division 1, 2, 3, etc., on the horizontal line v–20, draw vertical lines terminating in the line $u\ z$. These vertical lines will represent elements in the developed surface corresponding to the elements of the cylinder drawn through the points 1, 2, 3, etc, in the circumference $a\ e\ c\ v$.

To find the openings $y_2\ y_3\ x_2\ x_3$ in the developed surface we proceed as follows: In the circle $a\ e\ c\ v$ draw the horizontal lines $y\ y$ and $x\ x$ to represent the opening in the cylinder made by passing through it the prism; consequently the distance between the lines $y\ y$ and $x\ x$ must be equal to that between the line $h_2\ i_2$ and $m_2\ n_2$ in Fig. 299. In this particular case we find that the line $y\ y$ pierces the circumference $a\ e\ c\ v$ in the points of divisions marked 3 and 17. The line $x\ x$ pierces the circumference in the points of divisions marked 7 and 13. Therefore the opening on one side of the cylinder extends from the point 3 to point 7, and on the other side of cylinder the opening extends from the point 13 to the point 17. Consequently the openings in the developed surface must extend from the 3d to the 7th element, and from the 13th to the 17th element. Therefore, on the third element in the developed surface, lay off a point y_2; the distance between the points 3 and y_2 must be equal to that between the points b and a_4 in Fig. 305. Also from the point y_2 lay off on the third element a point y_3; the distance between the points y_2 and y_3 must be equal to that between the points a_4 and a_3. Through the points y_2 and y_3 draw the horizontal line $y_2\ x_2$ and $y_3\ x_3$, terminating in the seventh element, the rectangle $y_2\ y_3\ x_3 x_2$ will be the opening in the developed surface corresponding to the opening between the points 3 and 7 in the circumference $a\ e\ c\ v$. In a similar manner the other opening in the developed surface is to be found.

In rolling the circle $a\ e\ c\ v$ along the line v–20 its circumference will be developed, and when the circle has made a complete revolution along the line v–20 then the length of this line must be equal to the circumference of the circle. The length of this line has been found by laying off the same number of spaces as contained in the circumference; and since the spaces in the line v–20 are generally laid off by the means of dividers which are set to the distance between the points of division, v and 1, or 1 and 2, it follows that the length of the line v–20 thus obtained will be somewhat shorter than the circumference of the circle; the reason for this we will give in the next paper. Therefore it is always best to obtain the length of the line v–20 by calculation, thus: Multiply the diameter of the circle by 3.1416; the product will be the length of the line v–20. The length thus obtained is then divided into the same number of parts as spaced off in the circumference of the circle, and thereby obtaining the correct distances between the elements in the developed surface.

*For the manner of designating the lines or points in space represented by their projections, see Art. 332.

Foundry Cupola.

By Robert E. Masters.

The small cupola shown in this issue can be run from under the stack and turned upside down or held horizontally when chipping or daubing. It was designed by J. W. R. Johnson, of Richmond, Va., for a country shop in North Carolina, and is especially adapted for foundries doing a small business, or for quick heats on repair work in larger foundries.

We will begin at the top and work down, to give a description of making and erecting it. The platform *A A*, Figs. 1 and 2, is of cast-iron, 3 × 7 feet, made in open sand in one piece. This is supported by cast-iron angle posts *B B*. *C C* show the two forward posts broken off at *D D*. The cupola stack extends through the platform plate, and is fastened by wrought-iron angle irons at *E*. There is also an angle iron bolted to the inside at the bottom of the stack to support what brick is used in the upper part. The left-hand side of the stack is cut in two from *F* to *F*, and turned towards the reader, to show the charging door on a level with the platform.

To the right of the lower part of the furnace, Fig. 1, is an outside view; the left hand is the cupola cut through at *G G*, and turned back to show the position of sheave, tuyeres, etc. The upper half of Fig. 2 is the plan of stack and platform, while the lower part has half of the platform removed and the cupola cut through from *H* to *H*.

I I is a cast-iron ring riveted to the top of the shell, to hold the brick when the cupola is turned over. *J J* is a sheave roller on each side of the cupola, to run on track *K K*, which rests on a bracket cast in the uprights at *L*, and is also bolted to them at that point. Thus it will be seen that the lower part of the cupola is suspended by the sheaves resting on the track, as indicated by the dotted lines in Fig. 2.

From each of the air chambers *M*, on opposite sides of the cupola, are five tuyeres *N N* of 1¼″ gas pipe, for distribution of the blast. The branch pipes are of sheet iron, and can be attached, when ready to melt, to the air chambers at *O*. *P* is a peep hole. *Q* is an angle ring similar to the one used at the top. It has lugs at *R* to swing the drop door, which is fastened by a key through lug S.

When a heat has been taken off the key can be driven out from in front and the bottom dropped as it stands, or the lower half can be run back and turned upside down. The cupola is too small for a man to get in it and work, and the object of the drop door, and turning the cupola down horizontally, is to work from both ends to pick it out and daub it up. When it is run back under the stack the joint between the sections is daubed up. A bolt dropped through lugs at the joint keeps it from rolling back when in operation.

DIMENSIONS OF CUPOLA.

Outside diameter, top, 21½″; bottom	19½″
Thickness of lining	2½″
Inside diameter of tuyeres	14 ″
Inside diameter at charging door	16 ″
Height from bottom plate to bottom of tuyere	9 ″
Height of tuyere above sand bottom on back side	6 ″
Size and length of branch pipes	3½″ × 10′
Branch pipes connect with	6″ main blast pipe in smith shop.

MODE OF CHARGING CUPOLA.

Fuel used for bed ..... coke	90 lbs.
1st charge of iron, scrap, 200 lbs.; pig, 100 lbs.	
1st charge of fuel ..... coke	35 lbs.
2d charge of iron, scrap, 100 lbs.; pig, 100 lbs.	
2d charge of fuel ..... coke	35 lbs.
3d charge of iron, scrap, 100 lbs.; pig, 100 lbs.	
3d charge of fuel ..... coke	35 lbs.
4th charge of iron, scrap, 150 lbs.; pig, 50 lbs.	

MODE OF WORKING CUPOLA.

Time of starting fire	2. P. M.
Time of charging first iron ..	2.40 P. M.
Blast put on	2.55 P. M.
First appearance of fluid iron	3.01 P. M.
First stopped in	3.04 P. M.
Bottom dropped	4.15 P. M.

TOTALS.

Amount of iron melted	900 lbs.
Amount of fuel consumed	195 lbs.
Ratio of fuel to iron used	1 to $4\frac{6}{10}$.

At the Ramapo car wheel works they have a small cupola, something on the order of the lower half of the one shown. The bottom is one solid piece, and, of course, does not drop. It has no upper section or stack, and is suspended on a pair of trunnions, on which it revolves. They find it of great value in testing brands and mixtures of iron. When through taking off a heat the cupola is turned upside down and the contents drop out; it is, in fact, on the plan of a ladle, with the exception of a tap hole at the bottom, and the tuyeres about 10″ from the bottom.

In the American Machinist, June 14th, 1884, was illustrated a plan of melting a small quantity of iron by using a common ladle for the lower part, and placing on it a sheet-iron stack 36″ long, with tuyere holes at the bottom. Have the fuel high

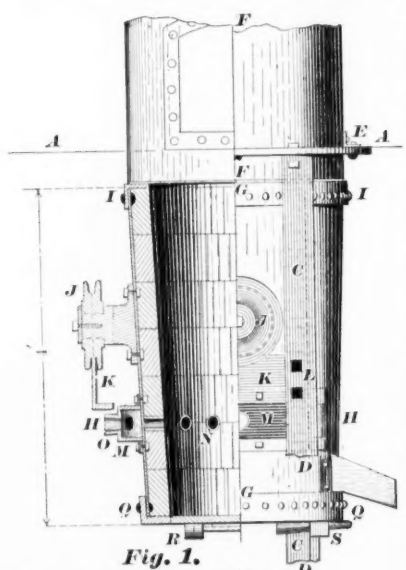


Fig. 1.

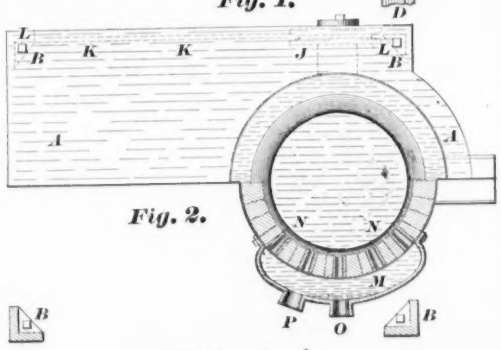


Fig. 2.

Foundry Cupola

enough above the tuyeres, apply a good strong blast, and as soon as the iron is melted lift off the stack and pour direct from the ladle. I fail to see why this iron cannot be poured as well from the ladle that it is melted into, as to have a tap hole at the base of the ladle, and run it into another ladle and then pour it. Any cupola below the tuyeres is on the principle of a ladle or reservoir, and if it could be transferred to a mould the metal could be run directly from it. This plan was republished in West's "Moulders' Text Book."

A writer in the American Machinist of February 12th, 1887, says he tried the plan, and "the effort was a grand failure," so he took two pieces of old smoke-stack, each 18″ in diameter and 2 feet long, one for the bottom and one for the stack, and melted the iron down, tapped it into a ladle and poured the mould, and has melted up to 1,500 pounds of iron successfully by this arrangement The writer referred to deserves a great deal of praise for this very creditable performance, yet this is one of the instances which proves that what one man makes "a grand failure" of, another will make a grand success of. Sometimes it is in the man, sometimes in the appliances used. Henry Duffey, of Columbus, Ga., has frequently melted down small quantities of iron into a common ladle, as described, thereby saving the amount of heat that is lost when melting it into the bottom of an old smoke-stack and transferring it to a ladle to pour it.

Early Engineering Reminiscences.

By George Escol Sellers.

THIRTY-SEVENTH PAPER.

Before the digester was put in service we had been greatly troubled with boiler scale and heavy deposits over the fire; more in the cylinder boiler that carried the 200 lb. pressure for the guns than in the two double-flue boilers provided with mud drum, such as is used on our river steamers. After a week's run of the digester the fire was drawn, and the boiler allowed to cool down before running out the water, which was found to be quite milky, from the minute portions of lime floating in it, considerable quantities having settled at the end of the boiler furthest from the fire, which, when washed out, left the inside of the boiler as clean as when it came from the boiler maker's, not a particle of scale having formed, and what had been left on at the last cleaning had fallen off. The cause of this was evident. The steam pipe from the boiler to the digester was provided with two globe cocks—one near the boiler, the other close to the digester. The steam pipe was so arranged that the drip of condensed steam was towards the boiler. On shutting off steam from the digester, the cock nearest the boiler had been closed and the digester allowed to make a revolution or two before the regulating cock close to it had been shut. The condensed steam, with its liquid extract of the cane in the digester, had run into the steam pipe, and when the steam cock was opened, with the regulating one closed, would naturally steep into the boiler. We immediately tried some of this liquid, mixed with the feed water, and fed by the injector into the other boilers; the result was, perfectly clean boilers, without any tendency to foam. Fearing it might have an injurious effect on the boiler iron, I submitted it to a test of filling a porcelain vessel with the liquid as it came from the digester, immersed in it coils of very fine-drawn iron wire and strips of thin sheet-iron, after removing all scale or rust. I placed this vessel on the stove, keeping it at nearly a boiling temperature, adding fresh liquid as it evaporated. This was continued until the residuum was about the consistence of molasses. I could not perceive any injurious effect on either the wire or the strips of sheet-iron. I can now add, that wire, left for years in a corked bottle of the liquid, remained uninjured. As a boiler cleaner, or preventer of scale, it seemed to present a use for another of the waste products; but, to make it available, it must be got into a more condensed or concentrated form, and, for that purpose we put up a large evaporating tank, heated by coils of pipe with the escape steam of our engine. Should there not be a sufficient demand as a boiler cleaner and scale preventer, I conceived the idea that, by carrying on the evaporation until reduced to a sufficient density, it might be substituted for molasses in shoe blacking; but in testing its deliquescence, I found it was lacking, for in the sun it dried into a hard, black, resinous substance. Besides the use in our own boilers, the concentrated liquid was furnished to one of the largest tow boats on the Ohio; also to the boats of the Evansville and Cairo Packet Company; from all of which we got most favorable reports.

The concentrating tank was set on a frame made of green white oak, freshly hewed from the tree when in full sap. Whenever the leakage from the tank came in contact with this green timber it dyed it to a jet black. By immersing in this hot liquid strips of dressed green oak, the same effect was produced, but on seasoned wood the black staining was not so perfect. The liquid extract from the digester carried with it a considerable quantity of the non-fibrous portion of the plant that I have called arundin; this settled in the tank, and when scooped out from the bottom and partially dried and mixed with the dry arundin would compress into the hard horny substance, such as I have before alluded to, without the addition of the animal size, of a darker color, harder, more compact, and susceptible of taking a finer degree of polish. As I had been looking to this as a substitute for molasses in shoe blacking, that was on my mind. From the fine smooth silky feel of the dry arundin, the question naturally occurred, if this could be brought to a jet black, would it not advantageously take the place of lampblack in shoe blacking? I took a quantity of the dust arundin as shaken from the digester and crushed cane, separated from it the fibrous particles by a bolting cloth sieve, added a small portion of tannin, and by livigation made it as fine as possible; then, by adding the hot liquid from the evaporating tank, I obtained a beautiful ebon-black, which, when in a dry state, by rubbing between fingers and thumb, had the feel of plumbago or blacklead, with its high polish but without its metallic luster. The next question was, without the use of acids that are so injurious to leather, and which are a necessity when lampblack is used, how much oil will this black powder carrry without the loss of its polishing property? On this I experimented, using castor oil, and for deliquescence New Orleans molasses, in one lot that I made, and in another, made at the same time, instead of the molasses I used the scoopings from the tank, with the addition of glycerine; I could not find any perceptible difference in these two lots. They were both a shoe blacking that took a high polish, lasting longer and being less effected by dampness than either French, English or American lamp black shoe blacking. There was freedom from acid with tannin as a preservative, and the large percentage of oil as a softener of the leather; there could be no doubt as to the demand for such blacking when once known. What I preserved of the only two lots I made lasted me for over a decade, and when exhausted I had no satisfaction in returning to the use of other blacking.

It had long been evident to me that, owing to the small yield from cane in white paper fiber, that making it for sale or into the finest grades of paper could not be made profitable without utilizing all the non-fibrous portions of the plant. I had demonstrated to my entire satisfaction that it could be accomplished with proper mechanical appliances, without resorting to the use of chemicals that are not only costly, but wastingly destructive to the fiber, save the chlorine required for bleaching. But to do this on a scale embracing all parts to make it profitable would require an entirely new plant, and expenditure far beyond my means. Having secured all the patents—eight in number—that I deemed essential, I contemplated forming a corporate company with ample means; but to do so successfully would require the completion of all plans for works and machinery; also demonstrative specimens of all the different products; to do this would require time and much labor. To enable me to devote my time to this, my son took entire charge of the business of the paper mill, then running successfully on cane wrapping paper, which was steadily improving in quality, and which he had succeded in bringing up to a yield of 50 per cent. of the green cane. Other important interests demanded so much of my time that I did not get on as fast with my preparations as I hoped to have done. The commercial part of the business of running the mill was intrusted to a commission

house in which we had full confidence, but it was not long before I was astounded by the return of drafts on them protested for non-payment. I at once went to Cincinnati and found that it was a complete failure, and that a large stock of our paper in their hands was hypothecated for advances to them. This could only be released by the payment of the advances, or by long and expensive litigation. I took the first course to release the paper, disposed of it, and closed the business with them by accepting all they had to offer—some mining stocks that proved to be worthless. It was the oft-told story of speculations outside of their legitimate business.

At this time a commercial traveler who had handled our paper, and who did much in introducing it, made a proposition in behalf of three young men, represented as having sufficient capital to operate the mill in manufacturing cane wrapping paper, to lease it, together with the right to run it under my patents. This proposition was favorably entertained, and a lease was given, certain betterments to be made on account of rent. These were done, and they started under very favorable prospects, but it was not many months before the commercial member of their firm disposed of the paper consigned to him without making returns, leaving the partner at the mill utterly stranded. We got no rent, and, as some of the betterments could be held as liens against the property, we had them to pay for.

Before we had decided what course to pursue, we were approached by a party who came out from New York to see us, and who represented the owners of certain patents for the production of paper stock from straw or other fibrous plants, with a great saving in the quantity and cost of chemicals; that a strong combination was formed, but before they could use their improvements without interference they desired to obtain the right to certain of my patents that antedated theirs. Thinking this might be an opportunity to get out, and recover a portion of the expenses I had incurred, several propositions to sell were discussed, and finally terms on which we would sell our mill and all of my patent rights were arrived at, subject to the approval of the Eastern parties. I soon received a dispatch calling me to Philadelphia, saying the terms were acceptable, and they were prepared to carry them out. When I arrived in Philadelphia I was met by Mr. Samuel A. Walsh, of New York, as representative of the parties, and owner of the patents. Instead of being prepared to carry out the agreement, as they had notified me, I was asked to grant time. This I at first refused, as I had been called to Philadelphia on a positive assurance. Mr. Walsh stated to me with great apparent candor what he had done and was doing, naming some of his associates, several of whom I knew by reputation. Among other matters he stated that he had organized successfully the American Wood Fiber Company, and, with the patents he now owned, combined with mine, he would have a much better showing. The time asked to complete his negotiations and pay for our mill and my patents was one year, during which time he would keep the mill fully insured against fire and in repair, and pay the hire of watchman or care-taker. He proposed for my security to make William and John Sellers, of Philadelphia, trustees, transferring all his six patent rights to them, with the agreement that if he failed to make the payments in the time stipulated, his patents were to become my property. My patents also to be assigned in trust to be conveyed to him on the payments being made. I never had met a man with whom I was more favorably impressed than I was with Mr. Walsh. I finally agreed to his proposition, but before executing the papers, without his knowledge I went to New York and saw two of the parties he had named as his associates, who fully confirmed what he had stated, and, at my request, a friend of mine saw two others, and wrote me to the same effect. After executing the papers I returned home, feeling confidence in Mr. Walsh meeting his engagements. I had inquiries from other parties wishing to purchase of me my rights; these I referred to Mr. Walsh. I frequently had from him reports as to progress and prospects. They were having a paper mill altered so as to fully demonstrate the value of our processes, and exhibit them in full operation. This mill had not been long running before it was destroyed by fire, and had to be rebuilt.

On reading in the New York papers the exposure of the great frauds of the Tweed ring, and seeing among their names some that Mr. Walsh had named as h s associates, I wrote to him, inquiring the effect it would have on his operations. To this he replied in person, coming out to Illinois. He expressed confidence that, as soon as the mill was again in operation, he wou.d have no difficulty in filling their places. I was notified when the mill started, and I went to New York State to see it, and I was surprised at seeing a great digester revolving on its short axis, precisely as mine had done. Its enormous size—being made to carry four or five tons of straw—made me uneasy during the entire time I remained in the mill. Very shortly after I saw the report of the explosion of this great digester. To my letter of inquiry as to the cause, Mr. Walsh replied that it was originally made to bear 200 lbs. to the square inch, but it had passed through the fire when the mill was burned; that a new one was being made, and he had advised against starting the mill until it was in place, but the proprietors, being pressed with orders, to save time had repaired the burnt one; that at the time of the explosion all the workmen had been killed, and that the real cause could never be known. Mr. Walsh seemed to be pursued by a succession of fatalities up to his untimely death, and when it occurred I was not in a position to renew my efforts.

I commenced this subject to show the folly of taking theory for fact in entering on any business, as I had done, and the theory on which it was based proved to be utterly fallacious; but it got me engaged on a work that I devoted six of the best years of my life to, and with great pecuniary loss. Yet I have the satisfaction of knowing that I have practically demonstrated the entire feasibility of reducing fibrous vegetable substances to paper stock, without resort to either acids or alkalies, or, in fact, any chemicals—simply by the agency of moisture and heat and proper mechanical manipulation.

And now that my letters patent, and, I presume, those held by Mr. Walsh, have expired, the highroad is open to the great and inexhaustible canebrakes, and the time will yet come when they will be utilized for paper and other valuable resultants, none of which need be wasted. Now, in my eightieth year, I have no disposition to re-engage in it, and I may not live to see it—but it is inevitable. The cane does not grow only for the uses it is now applied to.

A firm of English tool builders, in a communication to the *English Mechanic and World of Science*, speak of what they call the "excessive cuteness for minute details" of American builders. This we regard as a very good joke, the point of which will be seen at once by a comparison between American and English machine tools. Nothing is more certain than that this same "excessive cuteness" is largely responsible for the fact that many American tools are used in England and on the Continent.

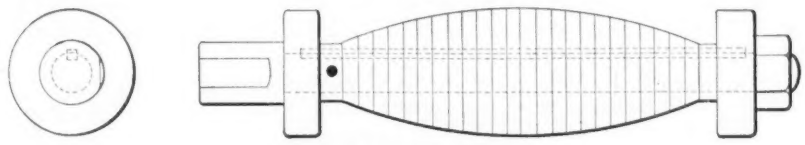
The long-continued discussion in English papers, and the tests that have been made, all incident to the bursting of the English steamer Elbe's steam-pipe, have brought out the fact that there is a good deal of inferior copper offered for sale.

LETTERS FROM PRACTICAL MEN.

Winding Conical Springs.

Editor American Machinist:

W. W. J., of Baltimore, can wind conical spiral springs by using the device shown by the accompanying sketch. The arbor is first made straight, as shown, with a small feather its entire length, over which is slipped, first,



WINDING CONICAL SPRINGS.

a collar provided with a hole to receive the end of the wire, then a lot of washers having keyways to fit the feather, and about $\frac{1}{16}$ inch thick, and finally a second collar, all of which are held in place by a nut, as shown.

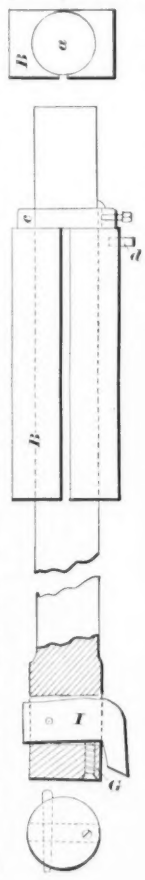
The washers are then turned up to the shape required. The spring can then be wound over the washers, after which the nut can be taken off and the rod slipped out, leaving the washers inside the spring, when, by opening the spring, they will fall out.

W.

Another Slotting Machine Bar.

Editor American Machinist:

In your January 21 and February 11 issues, I notice slotting machine bars to which I have some objections. The bars themselves are too heavy for the tools they hold, and have to be taken out to change them around. I have seen a good many slotting machine bars, and I think a description of the best bar that I have seen will be of benefit to some of your readers.



SLOTTING MACHINE BAR.

The bar itself is turned steel, left a little larger at the tool end. It is held in a steel or wrought-iron sleeve, planed square and left as large as will pass through the tool posts. There is only about an $\frac{1}{8}$" stock left on the narrow sides; one side is then cut open, so that when the set screws are tightened up the bar itself will be tight.

A small pin may be driven in the sleeve, to hold it from dropping down when loose, and a collar is put on the bar to hold that, so it can be turned round, lifted up or lowered, to suit the job, and held in place.

A tapered pin holds the tool in its place. The hole in the tool is reamed a little larger, so as to allow it to move easily. I never saw a tool of this kind break, and they are very easy to grind. A spring, as shown in the cut, holds the tool up. Tools can easily be made to cut down as far as the tool bar.

Geo. J. Mashek.

Marinette, Wis.

[We have received from Mr. Frank French, of Atlanta, Ga., a sketch and description of a bar almost identical with the above, so that the cut answers for both of them. Mr. French states that the bar was not originated by him, but that he has used one of them for years with entire satisfaction.]

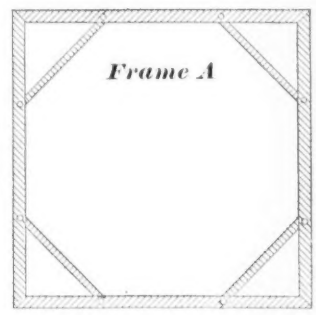
Moulding Pulleys.

Editor American Machinist:

There are times when the foreman of a foundry has to resort to different ways to get out castings. I once had a pattern brought to me 24 inches diameter and 12 inch face. The pattern was made in halves, old style. There was wanted a 16 inch face made from the 12 inch pattern. I got the flask in and had slides put on. Then I had a good level, smooth board made to ram it up on, then a board 2 inches thick that would go inside the flask. The pattern was placed on the 2 inch board and rammed up. After turning the flask over the 2 inch board was taken out and the pattern drawn up to the joint of the flask, which was 2 inches. Then the upper half of the pattern was placed on the first half and the cope rammed up; after the cope was rammed up and lifted off and turned over on its back on a good bed of sand; have a frame made 2 by 2 and place the frame *A* on the joint of the cope and fasten it with eight screws. Now you can draw up your pattern to the top of the frame and tuck up your arms and secure your cope by spiking or nailing the cope well, then draw out your pattern and finish the mould.

But some one will say that the hubs of the pulley will also be 4 inches longer. In the pulleys I made the hubs were loose, and when drawn out sand was put in the hub parts of the mould and the hubs placed back and bedded in so as to make them the same length. I cast some 6 or 8 pulleys from that pattern in that way and made nice castings.

D. Spence.



MOULDING PULLEYS.

The Wheel Question Again.

Editor American Machinist:

I read with interest your article on the car wheel question in the February 4 issue. In my communication printed in that issue no discourtesy was intended, and by your leave we will consider the question a little more.

First, I think we have a right to assume that when A. B. A. asked his question in the January 7 number, he did not appreciate the technical distinction between power and force, and was not aware of the contradiction of terms in saying the power was *fast* to the car, for the simple reason that if he had the technical education to distinguish all these fine differences, and their full import in relation to the problem, he would have known enough about it to answer and explain the question for himself and others without applying to the Machinist for information.

I assume that he wanted to know how many pounds' force would start the car applied at points (not wrist-pins, for cars do not usually have wrist-pins) *C* and *C'*, and acting always in horizontal lines. Wrist-pins usually imply connecting rods, and they do not act in parallel and horizontal lines, and always in one direction, as he indicates in his sketch. He did not really mean it when he said the power was *fast* to the car, for it is a contradiction of terms and an impossible condition. A draw-bar and link can be fast to a car, a cylinder can be fast to a locomotive, a piston and connecting-rod can be fast to the wrist-pin of a wheel, but none of these are powers or forces. *Steam* confined in the boiler is the *force*, and steam flowing and expanding through the cylinder against the piston and cylinder heads is the *power*, or *moving force*. Power cannot be *fast* to anything, for unless it moves it is not power, but force.

In a locomotive the power acts on a wrist-pin; the weight or resistance to be moved is the center of the axle, for that is the only point of the wheel that moves always at the same speed as the locomotive; when that center is moved it moves the whole engine. The fulcrum against which all the forces act is the point of contact between the bottom of the wheel and the top of the rail, for that is the only point that is stationary at

any given instant, while all other points are in motion; that is the point which is fast to the solid earth. Now, behold! our whole question is simply one of leverage. If we were treating the problem by differential calculus, the center of the wheel is to be moved an infinitesimal distance in a horizontal direction—that is to say, it only *starts* to move. Now, a pound is a force, and a foot pound is a power, and if it takes 24 pounds' force to start the car even the least or infinitesimal distance, it takes 24 foot pounds to move it one foot (supposing the starting and slow motion friction are equal, and even if they are not equal it does not change the argument) and 2 foot pounds to move it one inch, and 24 infinity foot pounds to start it. One might almost say that would be a case of *reductio ad absurdum*, but whether so or not, it would be rather unsatisfactory to the questioner. So we must say force starts the car, power keeps it moving—the force is a fixed, unchangeable quantity under the same conditions of friction, etc., while the power varies as the distance moved through varies.

The real point, I think, concerning which A. B. A. asks information, is as to the difference of force required to start the car, when the force is applied above or below the center of the wheel.

As an illustration, suppose a locomotive whose stroke of piston equals the diameter of the drive wheel, and leave out all considerations of the angularity of the connecting rod, by supposing the power of steam pressure acts in horizontal lines when the center of the wrist-pin is exactly above or below the center of the wheel. Now when the wrist-pin is exactly above the center of the wheel, steam moves the piston forward, and the wrist-pin is moving through space at twice the velocity of the center of the wheel, and the piston is also moving at twice the velocity of the cylinder; but when the crank is on the lower quarter and the center of the pin coincides with the point of contact between the wheel and rail, the wrist-pin center at that instant is standing absolutely still, and the piston is also still, but the steam is pushing the front cylinder head forward, and with it the whole train, just as it would if the back end of the connecting rod was pushing against the solid rock. Here we have a very interesting illustration of the principles of the lever and the action and reaction of forces. On the lower quarter, power moves the cylinder, and, coincident with it, the wheel center. On each dead center at the ends of the stroke, the forces are equal and opposite, and no work is done; on the upper quarter, the steam presses against the back cylinder head, and of course the wheel center, with the same force that it presses forward against the piston, but the piston or crank is at that point moving at double the speed of the wheel center, so we have force multiplied by velocity 1, opposed to force multiplied by velocity 2; the result is uniform velocity forward.

Of course it is entirely correct to say that a locomotive will start with the application of the same force, whether the crank is above or below the center, just as the editor argued, but the distinction is that the force acts on the engine or car as much, and sometimes more than it does on the wheel, and A. B. A. says it is applied to the wheel only.

From all this I claim that it is an impossibility to attach any kind of mechanism to the lowest point of the wheel, and by action of power on that point alone to move the car. If sufficient power is applied, the sliding friction of the wheel is overcome, and the wheel slips on the rail. If the mechanism which applies the power to that point is also attached to the car in some way, then the car may move, but it is only by action of the forces against the car.

Referring to Fig. 1, the whole resistance of the car or load to be overcome, centers at the wheel center A. The fulcrum or stationary point is D', the power can be applied at any of the points $D\ C\ A\ C'$ or D'. When applied horizontally at A, the force required equals the resistance; when applied at D the force equals one-half the resistance, at C two-thirds; at C' the force is twice the resistance, and at D' no power can move A. Sufficient power might move D', but the wheel would slip and A stand still, held back by the car and friction of the other wheels.

Now, to many every-day mechanics, diagrams, calculations and theory are not as satisfactory as actual trial with sticks, wheels, ropes and weights; in other words, they believe better what they can see and feel; so, since reading your article in the Feb. 4th number, I made a hastily constructed model, mostly of wood—somewhat as shown in sketch; see Figs. 2 and 3. The car had a post with a top sheave S and the lower sheave T, in an arm made to adjust to bring the rope R in a horizontal position when pulling on the different radii of the drum W, with its steps 3, 6 and 7 inches diameter, corresponding to the different distances of C, D and E, and C', D' and E' from the center A, in Fig. 1. The car wheels were six inches diameter, and, with the drum W, were fastened to the axle. The sheave V was made fast to the rails, but could be adjusted vertically to bring the rope Q level. The car with its load weighed 20 pounds, and the ropes could be wound around the drum either way, to apply the forces above or below the center.

The following will show the weights which were just sufficient to start the car

Fig. 1

Fig. 2

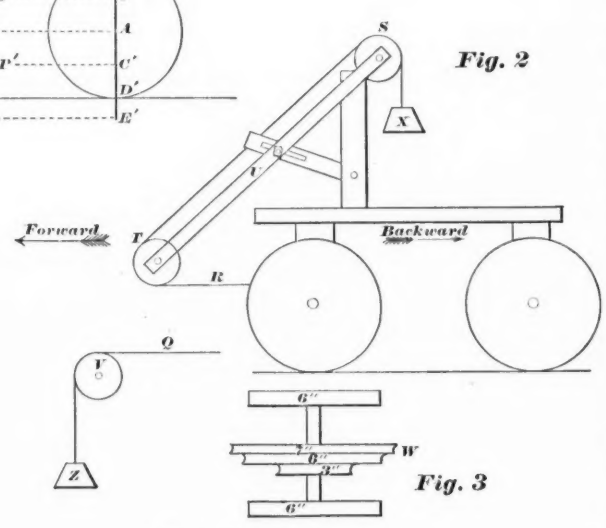


Fig. 3

THE WHEEL QUESTION.

when applied at different points on the perpendicular $E\ E'$ of Fig. 1.

When the rope Q was applied

at A	the weight Z	$= 8$	ounces.
at C	"	$= 5\frac{1}{2}$	"
at D	"	$= 3\frac{3}{4}$	"
at E	"	$= 2\frac{1}{2}$	"
at C'	"	$= 19$	"
at D'	"	$= 56$	" and

in this case the car did not start, but the wheels slipped on the rail. At E', $Z = 45$ ounces, and, the cars started backward; in the first five cases it started forward.

When the rope R was applied at A the car would not move under any force.

At C,	the weight X	$= 22$ oz.	car starts for'd
At D	"	$= 9$ oz.	" "
At E	"	$= 7$ oz.	" "
At C'	"	$= 21$ oz.	" backward.
At D'	"	$= 9\frac{1}{2}$ oz.	" "
At E'	"	$= 6$ oz.	" "

All the above figures are not precisely accurate, and do not correspond with each other exactly according to theory, but that is not the fault of the theory, but of the model and scales employed. They are sufficient to illustrate the principles.

In the first place where the weight Z and rope Q act it is a very simple problem of levers, the car starting forward in every case except when the point E' was used, and there, of course, the lever working on the fulcrum D' moved A backward.

In the second case, where the rope R and the weight X were used, it is still simply a question of levers and forces, but a little more complex and more interesting. The rope R is of course at all points under a strain equal to the weight X; it is, of course, always pulling horizontally backward on the sheave T, and arm V as much as it pulls forward on the point at which it is attached to the drum.

When it pulls backward on the sheave and arm, it in effect pulls backward on the whole car as concentrated at the point A; for that reason, when the rope was attached to A the car did not move, as the forces were equal and opposite.

So, then, we have the point A always pulled backward with a force equal to weight X, regardless of which point on the perpendicular the rope is attached to. At C', A is pulled backward 21 ounces, and C' is pulled forward 21 ounces, but A having twice the length of lever from fulcrum D', has $10\frac{1}{2}$ ounces advantage, and the car starts back. C is pulled forward 22 ounces, and A backward the same amount, but 22 at C is equal to 33 at A, so in that case A is pulled forward by 11 ounces, when the force is applied at D', and it is true, whether the rope was fastened to the drum or the track at that point, A was pulled backward $9\frac{1}{2}$ ounces. D' being the fulcrum, it cannot move, so A and the car start backward. Now, some one may say these last figures show that when the forces are applied at equal distances from the center A, as at C and C', and D and D', they are practically the same; but here is where the mistake would be; it is not the force applied at C' and D' which moves the car, but the car moves in spite of that force, by means of the greater force backward, and at the points C, D and E the forces would be much less were it not for that opposing force applied to the car.

The article in the February 4th number states that I am not very familiar with the few well-known principles of mechanics, am "entirely wrong," and am "grossly mistaken about sliding friction," etc, etc. I, on the contrary, think my answer to the problem was exactly correct. It was of no importance whatever that A. B. A. said the power was "fast" to the car, for he did not mean it strictly, and any one trying to discuss the question ought to have known its impossibility. He did say that the force (or power, as he called it) was applied to the wheel only, and at fixed points and in horizontal lines, and was only to start it. As to sliding friction, I claim that sufficient power applied to the lowest point of one wheel under a car will always slip it, and the car will not move, and if the car does move it is because the power is acting at some other point.

If A. B. A. sees this letter he will probably get some points of information, which neither of the former answers gave him, and it will likely answer most, or all, of the questions which he intended to ask, and any mechanic who has not given much thought to the theory of levers, and to the action and reaction of forces, if he will spend the time to look up and carefully read the question asked in the January 7th number, and follow closely the arguments in the two subsequent answers, he cannot fail to get information which will be of much practical benefit.

WILLIAM MERRILL.

East Saginaw, Mich.

[We frequently receive questions from our readers which bear with them the evidence that the writers are not thoroughly posted as to the nice distinctions between different terms and forms of expression, and we are obliged to use our best judgment as to what the questioner means or wants to know, as well as in giving the proper answer.

In the case of A. B. A., though he did not make use of strictly correct terms, yet by means of his letter of inquiry, and the original sketch which he sent us, we were convinced that this force was to act upon wrist-pins in a direct line, and that it was to act from a point on the car. In other words, that the car with its power was to be self-contained, or that, if the action were to be considered to be upon the wrist-pins, then the reaction would be upon the car, and *vice versa*. Of course we understood that in a certain sense the question was a theoretical one, because the question of the angularity of the connecting rods, which in practice are a necessary accompaniment to wrist-pins, was left out. We did not think, however, that any one need go astray upon that point, since by the terms of the question the car was only to be started. We answered the question with that understanding, supposing that every one who read it would so understand it.

If any proof as to the correctness of our answer were needed, it is to be found in the result of the experiments detailed above, where the rope R, acted upon by weight X, fulfills the conditions exactly. The experiments, however, are not new, and neither they nor the explanation of them reveal any laws or principles not perfectly well understood before.

To say that A. B. A.'s statement, that "the power was made fast to the car," was of "no consequence whatever," etc., is about equivalent to saying that, in answering questions, we should disregard plain statements made by questioners, and assume that they mean nothing, simply because they are not stated in strictly correct terms. In this case it certainly was not meant, by the words "fast to the car," that the force was outside of or independent of the car, but just the contrary; and to fail to answer a question which is evidently meant to be asked, or to evade it upon a mere quibble about words, is not in accordance with the object of our Question and Answer department.

From this last communication of Mr. Merrill's it is evident that the argument has been based simply upon a difference in the interpretation of the question, and there is ample inherent evidence that our interpretation of it was right.

The correctness of our answer, based upon that interpretation, is both admitted and proven in the above communication. As to what the car would do if the force acted from a point independent of it, is another matter, but is correctly explained in the above communication.]

Case-Hardening Cast Iron.—A Machinist's Makeshift.

Editor American Machinist:

The surface of cast-iron can be made very hard by using the prussiate of potash, and heat and cool three or four times using pot ash each time.

I am well acquainted with a machinist, who went out several years ago to put in some work on Sunday. He found he had to tap a hole in a boiler shell for pipe, and no tap to be had. The company employed several hundred men, and the works must start Monday morning. There was a Knowles steam pump there that had some of the openings closed with a plug the size he wanted. He took it and filed same as a tap, case-hardened it, and tapped the boiler shell all right, making a good job; where there is one man that would have done or thought of this, there are 1,000 that would not have done anything. This man was not a first class workman, but he always got the best pay of any man around the works, for the reason that he never got left.

F. W. W.

Castor Oil to Prevent Foaming in Boilers.

Editor American Machinist:

I have been troubled a great deal with foaming water in boilers taken from creeks

and pools. I have tried many ways to remedy the evil, but all the remedies that I could think of and read of failed me at times; but I have found one of late that has proven the best of all.

Several months ago I was having trouble with the water, so much so that I could not run the engine. The foreman of the mill said he had used castor oil in a boiler where alkali water was used, and that he thought this would help us out of the trouble. So I put two ounces of the oil in at the check valve, and in three minutes the water was still and clear. So when foaming began again I began with the oil. Generally two ounces would last a day, but at times I would have to use a pint.

My plan of handling boilers is to blow out some of the water at night or morning with about fifty pounds of steam, and put the oil in if foaming begins after starting the engine. I never blow all the water out of a boiler when hot if I can avoid it. This boiler is tubular, 44 inch diameter, 14 feet long, and carries from 100 to 120 pounds of steam. Engine 12×20; 190 revolutions.

B. W. Benson.

Checks in the Tool Room.

Editor American Machinist:

Mr. Miller's article upon the tool room touches a topic of importance in shop management. The value and necessity of a well-conducted tool room can scarcely be overstated. It is one of the time-saving, labor-saving, tool-saving and temper-saving arrangements which no thoroughly prosperous establishment can dispense with. Its highest efficiency can be impaired by slight details. I must differ from Mr. Miller as to the custody of the checks themselves. Why not apply the system of the tool room to the checks also? Don't let the men have them to get lost or mislaid, but keep them hung upon a board in the tool room. This will be found to save time and trouble, and will always enable the tool room keeper to know at a glance how many articles a man has out.

But you may say that if the men don't carry the checks they have nothing to show against the statements of the tool room keeper. The same objection could be urged against the conduct of every public library in the country. If the tool room man is not honest, he does not belong to any system that I care to talk about. But with an honest and careful man in the tool room to take care of the checks, you will have less trouble than if they are scattered among forty workmen, most of whom are honest and some of them careful. While five checks would be enough for most men, some others would need ten, and two or more classes would thus be formed. Instead of counting the checks as they hang upon the pins where they belong, a notched gauge applied to the side will indicate any deficiency.

Frank H. Richards.

Tool Rooms.

Editor American Machinist:

I have read Fred. J. Miller's notes on "The Tool Room" and appreciate them as every mechanic will, and as owners of shops should. Being a practical machinist, and having occasion to visit tool rooms from Boston to St. Louis, for the past few years, I begin to take it for granted that the object of building a tool room, in most cases, has been because it is the fashion. If I am correct in this opinion, most shops have attained the desired end; if, on the other hand, it has been the intention to have a place for the numerous small tools to be properly stored and kept in order, and a means of knowing how and by whom they are broken and carelessly destroyed, thereby knowing who was the careless man or boy to be made to use more brains and less brute force, the original intention has in a great many cases been forgotten soon after the tool room was finished.

I contend no shop is so small that a well-regulated tool room of some sort will not pay well for the time and expense of putting it up. Let any man who employs a number of hands go out in the shop and stay all day and keep account of time spent looking for tools and fixing up those that have been broken and thrown under the bench or behind that pile of castings over in the corner, and if he don't have a tool room and a means of knowing how thingsare kept, as well as where they can be found, he has missed his vocation.

Some day tool rooms will be more useful than they are at present, in the majority of cases. If you have a tool room, go and see if it is giving you perfect satisfaction. If you haven't any, you ought to build one, a good one, and after you get it done, keep an eye on it and it will surely pay.

Traveler.

A New Hoist.

At the great Paris Exhibition in 1889, one of the chief attractions will be the Eiffel Tower.

This tower is to be nearly 1,000 feet in height, and of course a large part, if not all of the expense of its erection, is expected to be paid by the people who may desire to go to the top of it during the exhibition.

In view of this, it became a serious problem how to get them up to the top of the tower and down again in sufficient numbers to make it remunerative. People will not climb steps to such a height, and indeed for most people it would practically be impossible. The ordinary winding engine and cage could not be made safe enough to inspire the necessary confidence in visitors, and consequently could not be employed.

The peculiar demands of the case led to the designing by M. Backman of the hoist illustrated herewith, and which was first described and illustrated in *Genie Civil*. It is a new principle of hoist construction, is applicable to any height, and appears to be entirely safe.

The construction will be readily understood from the drawings which we have reproduced. Briefly described, it consists of a truck having five wheels, each one at the end of a radial arm and resting upon a spiral or helicoidal railway. The truck being revolved by suitable mechanism, screws itself up or down, the cage with its passengers resting upon the truck and ascending and descending with it, but being prevented from rotation by vertical guides placed inside the rails and in which there are openings at suitable intervals to allow the axles of the truck wheels to pass through.

Referring to the engravings—Fig. 1 is a sectional elevation, Fig. 3 a plan of the truck, Fig. 4 a plan of the mechanism, and Fig. 2 a sectional view of some of the details. Each part is designated by the same letter in all the views.

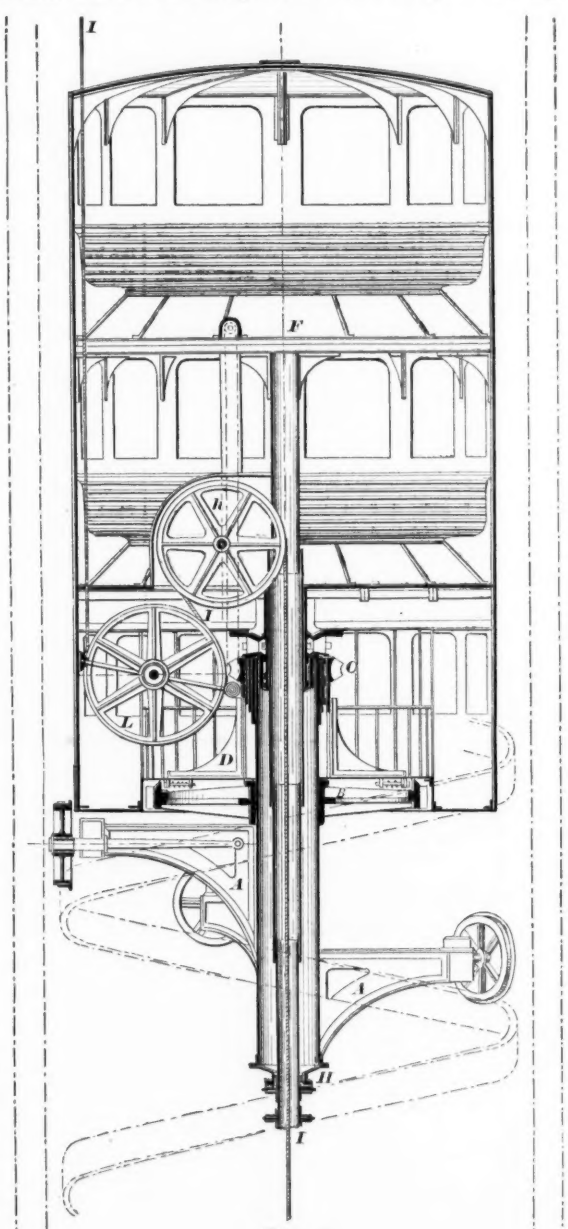


Fig. 1

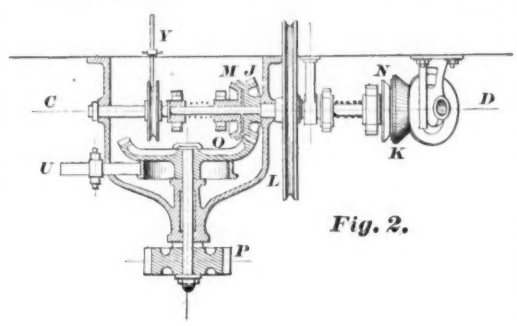


Fig. 2.

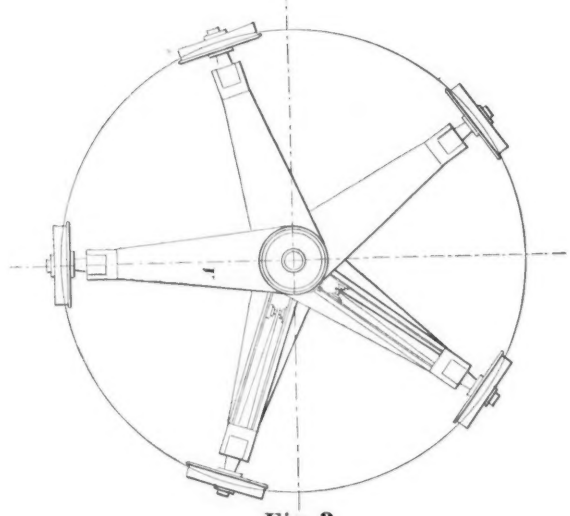


Fig. 3

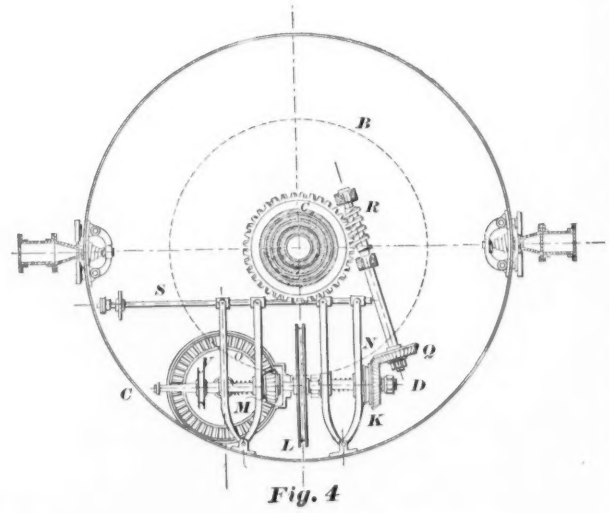


Fig. 4

A New Hoist.

Motion is imparted by means of the rope *I*, which passes up through a central tube and over two wheels, *h* and *L*. This rope is endless, and runs over a weighted pulley at the bottom, in order to maintain a uniform tension. It is about .6 inches in diameter, runs at a speed of 3,000 feet per minute, and is to be driven by an engine of 120 H. P. placed at the bottom of the tower. It runs at all times in the same direction, whether the hoist be ascending, descending, or standing still. The cage is in two stories, with a total capacity for carrying 100 passengers.

The truck consists of a large tube to which the five arms are fastened, and also the large spur gear *B*. Above the gear is the worm-wheel *C*, which is loose on the tube, but is connected to the wheel *B* by means of arms *D*, carrying spring plungers which engage with teeth inside of the rim of *B*. These teeth are so formed that if the wheel *B* is revolved in the direction to lower the cage the worm-wheel *C* must revolve with it, but if it revolves in the other direction the teeth do not lock and the worm-wheel does not turn. *L*, Figs. 1, 2, and 4, is the driving pulley, and on the same shaft with this pulley are two loose bevel gears, *J* and *K*. Either of these gears can be connected at will to the shaft by means of the friction clutches *M* and *N*.

The clutches are thrown in and out by means of levers, which are moved by the screw *S*, which is "right and left," so that when one clutch is thrown in, the other must necessarily be thrown out. The screw is turned by the operator by means of a hand chain passing over a wheel.

When the clutch *M* is thrown into gear, the bevel pinion *J*, by means of the bevel wheel *O* and pinion *P*, imparts motion to the large spur wheel *B* in the direction to raise the hoist, the worm-wheel *C* not being in motion.

In descending, the wheel *B* must turn in the opposite direction, the weight of the truck and carriage giving it motion. But when turning in this direction it must, for reasons stated above, turn the worm wheel *C*, and the angle of the spiral of the worm being such that the wheel cannot turn the worm, the hoist could not descend unless motion were imparted to the worm in the right direction, which is done by means of the clutch *N* and bevel gears *K* and *Q*.

Thus it will be seen that should the rope break, or the clutches refuse to act, the worm would not turn, and, consequently, the hoist could not descend; the worm simply allows the descent so long as the mechanism works properly. Brakes are also provided at *F* and *V*.

The large tube is journaled at top and bottom upon the inner tube, to which is attached the cage. To secure a uniform distribution of weight upon the truck wheels, the axles are pivoted at the inner ends, while the bearings next the wheels are supported upon springs, and have a vertical movement of about $\frac{3}{4}$ in. The diameter of the spiral is about 13 feet, and its inclination to the horizontal 18°. Since the rope always runs in the same direction, no signals are required between the cage and the engine, and by dividing the mechanism into two parts—one for the ascent, and the other for the descent—the greatest efficiency is secured in hoisting the load, and the greatest security in descending.

AMERICAN MACHINIST

To prevent delays all Communications should be addressed to the Company.

PUBLISHED WEEKLY
BY
American Machinist Publishing Co.
96 Fulton Street, New York.

Horace B. Miller, Pres't and Bus. Manager.
Lycurgus B. Moore, Treas. and Sec'y.

F. F. Hemenway, Editor and Mech. Engineer.
J. G. A. Meyer, Fred J. Miller, } Associates.

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"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 Bouverie Street, Fleet Street, London, Eng., will receive subscriptions for the American Machinist, at 14/7 per annum, postage paid.

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NEW YORK, MARCH 10, 1888.

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Fair Play for Manufacturers.

In many of the older cities of the country there is complaint from manufacturers that they do not receive the consideration in city matters generally that is their due, from a proper recognition of the importance of their operations. And we believe that there is good ground for this complaint. Manufacturers are sometimes considered good subjects upon which to levy taxes; their assets are generally in plain sight, and more easily come at than many others; hence they are disproportionately taxed.

Then manufacturers sometimes require special privileges, and there are often foolish objections raised against granting them. Such things tend to worry and disturb manufacturers, and often lead to removal, at a good deal of cost, and corresponding loss to the city.

In one city we know of, the disposition to overtax manufacturers, and objections to granting trifling privileges, have driven several important manufacturing enterprises to other parts of the country, and the citizens, although partially awakened to the loss, are still likely to drowse over the matter till the loss is materially increased; then the usual course of giving bonuses and remitting taxes will be gone over, and it will cost a good deal of money to get back the equivalent of what might have been kept by the practice of fair business methods.

It seems to be assumed that the cost of removal will be sufficient to hinder manufacturers from changing their location, and this does very generally operate to do so. But it will not always avail. As a manufacturing business extends, there is likely to come a time when new and larger works are required; then the kind of consideration that has been received, and the kind that is promised elsewhere, are important factors in determining the location.

When it is decided to move the location of a manufactory from one city to another, there are reasons for doing so that should be carefully looked after. This removal very likely means others to follow. If there is something in the way of inducement in the place to which the removal is to be made, why could not that something be found in the original location?

Manufacturers are conservative, and do not remove without what appears to them good and sufficient reason. When an exodus of this kind begins, the reason should be looked after sharply. The time has long since passed when a city in this country can expect to amount to much without manufacture. New York is a great city commercially, but at the same time it is the greatest manufacturing city in the world. Remove its manufacturing interests, and much of its glory would depart.

Fasting as a Cure for Poverty.

A mistake of quite frequent occurrence is to suppose that because a person may have developed considerable talent in some given field of knowledge he is therefore entitled to express his views upon almost every subject which may arise, and to have those views bear with them especial weight and authority, even though they be entirely foreign to the subject upon which he has especially qualified himself to speak, or even though they relate to a subject which both his natural mental endowments and the peculiar line of study pursued by him may have unfitted him for discussing.

Because a man, by reason of natural talents and industry, may have risen to eminence in some special department of the field of knowledge, so that his opinions upon matters relating to that subject are recognized as authoritative, it by no means follows that it is his duty to volunteer instruction on other subjects for which neither his natural abilities nor his training qualify him to speak; but if he choose to do so, it certainly is not required that others shall receive those opinions, and attach to them any special significance or importance more than would be attached to the utterances of any other person talking of a subject about which he might reasonably be expected to know no more than any one else.

Some of the papers are now devoting a considerable part of their space to extracts from and comments upon a magazine article by Richard A. Proctor, entitled "A Remedy for Poverty," in which he seems to hold out the idea that one of the chief reasons for the existence of poverty is the fact that people eat too much. He gives the average daily consumption of solid and liquid food by "soldiers, sailors, artisans and prisoners" in England, and states that modern doctors agree that "this amount is in excess of the real daily requirements of a healthy man or woman," and that "they would thrive better and enjoy life better on half the quantity," a statement which, since it comes from the doctors, it would probably be presumptuous for us to deny the truth of though we don't believe a word of it.

Mr. Proctor, however, taking this as a foundation, concludes that it is possible for workmen to live upon about one-half the quantity of food which they now consume, and that they could therefore save what they now spend for the other half, and thus greatly improve their condition, and "deprive capital of much of that portion of its control over labor which must be regarded as unjust and injurious," whatever that may mean.

Now, an opinion relating to astronomy held by Mr. Proctor would undoubtedly be entitled to the profoundest respect, because he is learned in the science of astronomy; but this opinion upon an economic question, it seems to us, should not be taken as authoritative simply because uttered by a famous astronomer.

If, as is claimed, working people would enjoy better health and be happier by reducing their food consumption one-half, their producing powers would not be diminished at all in consequence, and what would become of the surplus food produced? Will the wealthy make a still greater proportionate sacrifice of their health and happiness by consuming this surplus, so as to keep the producers employed? It is evident that Mr. Proctor's study of celestial affairs has not led him to observe that the cost of living has much to do with fixing the final rate of wages, and that, to quote a recent writer, "the rate of wages in any community is fixed by the standard of living set for himself by the workman."

A. J. Stevens.

A. J. Stevens, General Master Mechanic of the Central Pacific railroad, died at Sacramento, Cal., on the 11th of February, of Bright's disease, from which he had been a sufferer for some months previous. Mr. Stevens was born at Barnard, Vt., in 1833, and served an apprenticeship in the Northern railway shops at Concord, N. H. From that time until 1870, when he was appointed master mechanic of the Southern Pacific railroad, he had a varied experience as machinist, foreman, locomotive engineer, and master mechanic for different railroad companies. This diversified experience was of great advantage to him in connection with his work on the Pacific roads, where he soon made his mark as one of the foremost master mechanics of the country. It was largely due to him that the Southern Pacific shops at Sacramento assumed their present proportions, he early taking the ground that locomotives could be built there at less cost than was involved in their purchase.

The aggregate of money withdrawn from the savings banks of New York city was $11,000,000 greater in 1887 than in 1886. The deposits for 1887 show an increase of $3,000,000 as compared with 1886, but the fact that the withdrawals were so much greater in 1887, is not easily explained. Deposits in and withdrawals from savings banks are generally held to be a fair indication of the condition of those who work for wages.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(112) E. M., Sherbrooke, ——, writes: I am making an engine 1⅜ x 1¾ inch, to run 200 revolutions. What power will I get with boiler pressure from 25 to 50 pounds? *A.*—From 3-100 to 6-100 of a horse-power.

(113) F. P. S., Clinton, Mass., asks: What is the advantage to be gained by speeding a forty-horse power engine from 60 to, 90 revolutions per minute, without changing the speed of the machinery? *A.*—Everything else being equal, the power of the engine will be increased 50 per cent.

(114) C. M., ——, asks: In making common friction calipers should the bearing surface of the washers be level or hollow at the center? *A.*—They are usually made flat, but if made concave and rather thin, then tempered so as to make a spring washer, the joint is much improved.

(115) J. A., Marinette, Wis., writes: I have a dispute with a friend about a valve stem. The stem has a right and left nut for changing its length. I say when you turn this nut it changes the lead on both ends alike. He says it will only change it on one end. Which is right? *A.*—Your friend is right. By moving this nut you will increase the lead on one end, and decrease it to exactly the same extent on the other end. If you want more or less lead on both ends you must move your eccentric.

(116) A. H. A., Greenville, Cal., writes: To settle a dispute here among the boys, please state whether or not, when a wagon or buggy is in motion on the road, the top parts of the wheels travel faster than the bottom parts? *A.*—They do. That part of the wheel which is in contact with the ground cannot travel at all without slipping, while the top of the wheel is for an instant moving at twice the speed of the vehicle, though of course the angular velocity about the hub is always the same in all parts of the wheel.

(117) J. A. R., Toronto, Canada, writes: Would you kindly give me the name of a book for an amateur engineer to study. I have charge of a stationary engine; I know that to open and close certain valves will start and stop the engine, but would like to know more of it. I have a book by John Bourne, C. E., but it is too complicated; it is only fit for an experienced engineer; I would like something more simple. *A.*—John Bourne has written several books; we do not know of a simpler book than his Catechism of the steam engine. You must not expect to learn the principles of a steam engine without some study.

(118) Mediator, Boston, Mass., asks: 1. What is required of a perpetual motion machine—simply to furnish its own motive power, or something more? *A.*—A machine which, once put in motion, would continue its motion until worn out without further application of force outside the machine itself would be a perpetual motion machine. 2. Is there an award awaiting the lucky inventor, and if so, how much? *A.*—We are not aware that anyone has offered a reward for the invention of such a machine, although it would be entirely safe to do so. 3. Are there any alleged perpetual motion machines on the market? *A.*—No

(119) O. W., Astoria, N. Y. writes: I am running a Corliss engine 18 x 36 inches, fly-wheel 12 feet by 21 inches, 80 revolutions per minute with 80 pounds steam pressure. This engine is 151 horse-power, cutting off at one-quarter stroke. All the power we require is 30 horse-power, when all the machinery is working, and sometimes there is not more than 5 horse-power; then the engine runs unsteadily. What I want to know is if, by changing the speed to 60 revolutions, the engine will work better, and if so, what changes will I have to make? The governor makes 70 revolutions per minute. *A.*—We do not know how heavy your fly-wheel is; much will depend upon this. If you have a heavy enough fly-wheel the engine would do better at 60 or even 50 revolutions. To change the speed of the engine to 60 revolutions, you must arrange to still run the governor at 70 revolutions. To do this you must change the size of one of the governor pulleys. It would be preferable to put a larger governor pulley on the shaft. To find the size of this pulley multiply the diameter of the present pulley in inches by 80, and divide by 60. For example, if the present pulley on shaft is, say 12 inches diameter, then the pulley required will be

$$\frac{12 \times 80}{60} = 16$$

inches diameter. Or if you change the pulley on the governor you must make it smaller, and to find the size multiply the present diameter by 60 and divide by 80. Then you will have to belt from the engine to a smaller pulley to keep the speed of line shaft the same. To find the size of this pulley multiply the diameter of the pulley on the line shaft to which you belt by 60, and divide by 80. In other words, make the diameter three-fourths as great as at present.

(120) **A. M., New York, asks:** How can I find the center of gravity of a safety valve lever? *A.*—Balance over any sharp edge; your knife blade will do.

(121) **J. M. T., Pulaski, Tenn., asks:** 1. Can you tell me the process by which chilled iron is cut? Can it be cut by ordinary tools? What is the best brand of steel to make them of, and the best method by which to harden them? *A.*—Chilled rolls are turned by the use of tools, made of ordinary good steel, though steel makers usually prefer to furnish a grade of steel adapted especially to this purpose. They are made as hard as possible by the ordinary methods of hardening, aud the speed is very slow.

(122) **S. & S., Meridian, Miss., writes:** Are you not mistaken in your answer to J. G. T. Corvallis, by saying there are no objections to the use of steel for boilers—excepting it is the price of steel? We know of many who prefer iron and pay more for it. Please give us your reason why you think steel the best for boilers. *A.*—We prefer steel, because we believe it to be a stronger material and safer to use for boilers than iron; also in ordering steel plates we have a greater assurance of obtaining perfect and homogeneous plates than when ordering iron sheets. That many other persons hold the same opinion may be seen in the fact that a great majority of locomotive boilers are now built of steel.

(123) **J. W. T., Thornton, Ark., writes:** Our driving belt from main to countershaft of saw mill is 20 inches wide, with a tightener at the countershaft. If a tightener was placed near the main shaft of the engine, would it not take the wave out of the belt and be easier on the engine? Would it make the belt slip any more by placing two tighteners on it? *A.*—The placing of another tightener would reduce the waving of the belt; whether it would be easier on the engine or not depends upon whether the waving is sufficient to injuriously affect the engine or not. A gentle wave in a belt of any considerable length is a good thing. It would not make the belt slip any more unless it were so applied as to lessen the arc of contact. If its application increases that arc it will tend to prevent slipping.

(124) **J. D. E., Toronto, Can., asks:** 1. Will an ordinary square-nosed (or cutting-off tool) set at a right angle to the centers, cut a good square thread? If not, what should be the shape of the tool? *A.*—Such a tool will cut a good square thread, provided it is short enough to give it sufficient rigidity to prevent springing, and provided also that the angle of the spiral of the thread is not so great as to make the tool bind on one side. The shape of the tool should be similar to that of an ordinary cut-off tool, except that it should be shorter. The blade should be thinner at the bottom than at the top, and also slightly thinner at the back than at the cutting point. Then it should incline to the right or left at about the same angle as the spiral of the thread. 2. What is the rule for finding the width and depth of a square thread? *A.*—The width is one-half the pitch, and the depth 19-20 of width.

(125) **A. O. K., New York, writes:** Please inform me if a boiler of the following dimensions is large enough to run an engine with a cylinder four inches in diameter and 6 inch stroke, making 250 revolutions per minute, with a steam pressure of 80 pounds per square inch. Dimensions of boiler are 34 inches diameter, 46 inches high. 80 flues 2 inches in diameter and 22 inches long; the furnace 16 inches high and 30 inches in diameter; the hood and stack are 5 feet high. If this boiler is not large enough, give the proper grate and heating surface, also horse-power of the engine. *A.*—Cutting off steam at about ⅜ of the stroke you will obtain about 4¾ horse-power. The boiler is large enough, but not as correctly proportioned as it should be for economy of fuel. Flues less in number and greater in length will be better. The total area of the flue opening should be about 1-6 of the area of the grate, and the length of the flues made to contain the same heating surface you have now.

(126) **Subscriber, Charlotte, N. C.,** writes: My apprenticeship in the machine shop will end in one year, when I will be 18 years old. I want to be a mechanical engineer. Will you kindly advise me what school to attend. If possible I want to work some and study some, so I will not lose the use of tools. I thought of trying to enter the Asa Packer Institute at Lehigh, Pa., but would prefer a school that includes work with study. I wish especially to learn mechanical drawing and other things equally useful before I go off to school. *A.*—We would advise you to write a number of institutions in which the science of mechanical engineering is taught and obtain a catalogue from each. The catalogues will indicate the course of study pursued in each school, and will enable you to decide which institute to enter. These catalogues will also indicate the studies with which a candidate must be familiar, and consequently will enable you to make the proper selection of books to study before you enter the regular course of mechanical engineering. As for drawing, it seems to us that the articles on Practical Drawing, now appearing in the AMERICAN MACHINIST, will enable you to obtain a knowledge of mechanical drawing.

(127) **Subscriber, Great Falls, N. H.,** asks: How much more power will it take to run a machine that takes 10 horse-power close to the engine, when the machine is moved 250 feet away from it? Shafting 1 15-16 inch in diameter. *A.*—The extra power to run the machine placed 250 feet away will be that which is required to overcome the friction in the bearings of the shaft. If the shaft is properly lined up, and the engine run at the correct number of revolutions, then the friction will be very small. Therefore it may be said that practically there will be no difference in the power required.

(128) **F. A. H., North Tarrytown, N Y.,** asks: Can you give me any hints relative to hardening long slender taps and such like tools without springing? Some special tools of this kind we have to make and cannot get them nearly so good as those we buy? *A.*—The best hints we can give you would be to turn the tools near to size and then anneal them, to take out strains caused by forging, or which may have been in the bar. In heating, see that the increase of heat from the time it is put into the fire until it is at the proper heat, is as near uniform as possible all over the tool. Then dip it straight into the water without lateral motion. When you re-heat it to draw the temper you can then straighten it while warm by the ordinary means employed for such purposes if it is found to be sprung. No means have been discovered which entirely prevent springing.

(130) **A. G. K., Winchendon, Mass.,** writes: 1. Suppose we wish to raise 150,000 gallons of water in 10 hours to a height of 150 feet. We have a good engine of 40 horse-power working with a very light load. Would it be best to use a power pump belted from the engine, or a direct acting steam pump, taking steam from the same boiler? *A.*—The engine being considerable larger than required for raising the amount of water, we would prefer a direct-acting steam pump, so that the engine need not be run for pumping water at times when there is nothing else for the engine to do. If the engine must be run every day for other purposes requiring only a part of the power of the engine, then economy in fuel will be promoted by adopting a force pump and driving it from the engine. 2. If a power pump is used, would you prefer a piston or some form of rotary pump? *A.*—That depends on the location of pump and general arrangement of pipes. Our advice to you is to write to several pump builders, obtain their catalogues, and choose that kind of pump which will suit your purposes best. 3. About what power will be required to drive the pump, the work of lifting the water being about 9½ horse-power? *A.*—Impossible for us to say without knowing more about the arrangement of pipes, so that the proper allowance for friction can be made.

(131) **C., Brooklyn, N. Y., asks:** 1. What should be the cubical contents of a boiler per indicated horse-power? *A.*—There is no rule for this; practice varies widely in the different forms of boilers in use. Besides, an indicated horse-power may require four times the steam with one engine that it does with another. 2. What should be the heating surface per horse-power? *A.*—The allowance is generally from 12 to 15 feet. This may be more than sufficient, or it may not be sufficient, according to the efficiency of the engine that uses the steam. 3. What should be the area of grate surface per indicated horse-power? *A.*—The grate surface of a boiler is proportional to the heating surface, usually being from 1-25 to 1-35 of the latter. If you count 15 feet of heating surface equal to a horse-power, and have one foot of grate surface to 30 feet of heating surface, then you will have ½ foot of grate surface per horse-power. From ⅓ to ½ foot is quite common practice. 4. How can I calculate the saving in fuel by heating feed-water, say from 50° F. to 130° F. *A.*—Find by the aid of steam tables how much heat you must impart to the water to convert it into steam at the observed pressure, then find how much of this heat you impart in the heater, and you can readily find the percentage. For example, suppose you are carrying steam of 70 pounds pressure by gauge. Steam of that pressure contains 1210.3 heat units per pound. This is reckoning from zero. A pound of water at 50° contains 50 heat units, leaving to be imparted 1210.3 − 50 = 1160.3 heat units. Water at a temperature of 130° contains 130.2 heat units per pound, so there was imparted in the heater, 130.2 − 50 = 80.2 heat units per pound. This is about 7 per cent. of 1160.3, so the heater should be credited with 7 per cent. of the work of converting the water into steam of 70 pounds pressure.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Planed bevel gears. Grant, see page 16.

Link-Belting.
Send for catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Machinery Co., Chicago and N. Y.

New features on engine lathes, Lodge, Davis & Co
New features on drill presses, Lodge, Davis & Co.
New features on shapers, Lodge Davis & Co.
New features on brass tools, Lodge, Davis & Co.
Special bargains in tools taken in exchange for ours Lodge, Davis & Co.
See special ads. pages 15 and 16, Lodge, Davis & Co.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee Falls, Mass.

Machine work and pattern making. Anderson Machine Works, Peekskill, N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Mechanical drawing, calculations, etc., taught by mail. I. D. Boyer, 324 E. 3d st., Dayton, O.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Light and fine machinery to order; foot lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

For first-class automatic engines write to Williams Engine Co., 447 North street, Baltimore, Md.

The bulldozer forming, forging and bending machine. Williams, White & Co., Moline, Ill., m'f'rs.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N.Y.

Burnham's turbine wheel is sold at net price to mill owners. Catalogue free. Address York, Pa.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Berryman Patent Feed Water Heater and Purifier, and the Economic Boiler Feed Pump. Benj. F. Kelley, 91 Liberty st., New York.

Nicholson & Waterman, Providence, R. I., two 48 in. horizontal boring mills; 5 in. cutting-off machines; 14, 16, and 30 in. engine lathes.

Iron, brass and copper spooled wire is a necessity to the consumer and a great convenience to the trade. S. A. Smith, agent, 23 Canal st., Chicago, Ill.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See Feb. 11, p 10. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

New book on gears; ask dealers in books and machinists' fine tools to send for one, or send for one yourself by P. O. note. Price, 50 cents. Address Chas. B. Long, M. E., Worcester, Mass.

Randall's copper-tipped hammers are something that every machinist should have; ask your dealer to show you one, and if he does not keep them, write to Montgomery & Co., 105 Fulton st., N. Y.

W. H. Hoffman, consulting engineer, 94 Liberty st., N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Special facilities for manufacturing of all kinds of light hardware and novelties by contract or otherwise; presswork and stamping done on short notice. Acme B. H. Att Co., Limited, 74 5th ave., N. Y.

Patents relating to machinery should be secured by experienced mechanics acquainted with the law. Write to A. K. Mansfield & Co., mechanical engineers and patent experts, 280 Broadway, N. Y.

Parties requiring milling machine or screw machine work furnished, in large or small quantities, will please write to the manufacturers, E. E. Garvin & Co., 139, 141, 143 Centre st., New York City

The Dieble Mfg. Co., Philadelphia, Pa., mfrs. of the Challenge emery grinding and polishing machinery, invite correspondence with all needing this class of machinery. Catalogues and prices on application.

Hot Water Supply. A practical treatise on the fitting of hot-water apparatus for domestic and general purposes. By F. Dye. 82 pages, with 25 illustrations. 12mo., cloth, $1. Send for catalogue. E. & F. N. Spon, 35 Murray st., N. Y

Wanted—Numbers 1, 2 and 4 of volume IV., 1881; must be in excellent condition for binding; if soiled we cannot use them; for copies described as above we will pay 25c. each, and prefer to have the whole three if possible. Parties favoring us will kindly write name and address on wrapper. AM. MACHINIST Publishing Co., 96 Fulton street, N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G Co., 96 Fulton st., New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October, 23, 1886 issue, and up to and including January 14, 1888 issue, 41 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton street, New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 56 articles have thus far appeared up to and including the January 21, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING Co., 96 Fulton street, New York.

MANUFACTURES.

An ice factory is to be built at Tallapoosa, Ga., by E. C. Pierce.

Parks & Arnold will build a carriage factory at Newnan, Ga.

Dewey Bros. are building an iron foundry at Goldsboro, N. C.

Kester Brothers are building a machine shop and foundry at Salem, N. C.

A steam saw mill is to be built at Kingman, Maine, by J. S. Richardson.

J. T. Buchanan contemplates starting an iron foundry at La Grange, Ga.

The Martin Anti-Fire Car Heater Company are building shops at Dunkirk, N. Y.

Cummings, Johnson & Wilkerson will build a sash and blind factory at Greenwood, S. C.

A. Edwards is interested in an Electric Light and Water Works Company, at Decatur, Texas.

A. S. Smith, of Cincinnati, Ohio, will soon begin the manufacture of shapers of his own design.

The Wyeth City Land and Improvement Company will build a paper mill at Guntersville, Ala.

The Hope (Ala.) Lumber Company will probably build mills for making flooring, ceiling, sash and blinds, furniture, etc.

A company known as the American Safety Signal System Company has been chartered to manufacture electrical devices at New Orleans, La.

The Sprague Electric Railway & Motor Company, New York, has issued in pamphlet form the report of Richard Moldenke on the use of electricity as a motive power in mines.

Thos. Carlin's Sons, Allegheny, Pa., have issued a catalogue of engines, boilers, contractors' machinery, pumps, and general machinery. The catalogue is quite fully illustrated.

James Rees, Pittsburgh, Pa., has lately remodeled his large mills and is now manufacturing the Pittsburgh automatic engine rolling mill machinery—mining machinery, etc. He has put up new buildings and put in new tools at a cost of $50,000.

The Mason Regulator Company, Boston, Mass., has issued a finely illustrated and printed large size four page circular and price list of their specialties, such as reducing valves, pump regulators and governors, and valves for various purposes.

Russell, Boynton & Co. have been appointed agents at Minneapolis, Minn., for B. W. Payne & Sons, of Elmira, N. Y. They will carry a stock of the Payne automatic engines, of which there are a large number in use in Minneapolis and vicinity.

The Stiles & Parker Press Company, Middletown, Conn., and 203-207 Centre street, New York, have issued a large sheet of engravings of presses, drop hammers, shears, and machines made by them. The engravings are excellent and well printed, the whole making a large ornamental picture.

The Kokoma, Ind., *Gazette* says: The cable rope and rod works, should they locate here—and they are reasonably certain so to do—will occupy a two-story brick building, 60 x 150 feet, with metal or slate roof, the plant to cost $50,000 and give employment to 40 men.

The new foundry of the East Buffalo (N. Y.) Iron Works is complete and in running order. The floor, actual working space, is 315 feet x 80 feet, and the cupolas have a combined capacity of 150 tons per day. This is the largest foundry in Buffalo. The foundry starts in with some large contracts for railroad work, and will pour about 60 tons per day through this month.

The Consolidated Wellston Coal and Iron Company has purchased the Milton furnace now in operation in the limits of Wellston, Ohio. The company will erect during the year additional furnaces and a steel plant. In the latter the molten iron from the furnace will be converted into steel and then rolled into wire and marketed as plain wire or barbed wire for fences. It is proposed not to let the metal get cool, from the time the ore goes in to the furnace until the finished product is ready for shipment.

The Rice & Griffin Manufacturing Company, sash and blind manufacturers of Worcester, Mass., will run their shop on the following plan the coming year: "After reserving 6 per cent. on the value of the capital invested, the balance will be divided proportionately between the capital and the yearly pay roll, employes to share according to the amount of their wages for the year." The works were run upon some such plan last year, and the result appears to have been satisfactory.

A St. Louis, Mo., dispatch says: A large number of manufacturers of barb wire assembled in convention in this city to-day for the purpose of adjusting, if possible, the royalty claim of Washburn & Moen, owners of patents. The manufacturers generally refuse to longer pay their royalty and effort is being made to have Washburn and Moen rebate their claim. No understanding has yet been reached, Mr. Washburn declaring that the royalty, which now nets his firm $350,000 per year, will certainly not be relinquished. The manufacturers seem to be equally determined not to pay it.

A Phillips, Maine, correspondent of the *Industrial Gazette* writes: Phillips is the terminus of the Sandy River railroad, and the gateway to the famous Rangeley Lakes, destined in the near future to be one of the great watering places of New England. This is a lumber and agricultural district. Sheep husbandry is one of our leading industries, and such lumber as spruce, white and yellow birch, rock maple, beech, red oak, ash, poplar and hemlock, are abundant, while pine is found in considerable quantities, though not so plenty as formerly. The people of Phillips are anxious to have these resources utilized, and very liberal assistance will be granted any capitalists who will come here and operate a woolen mill, or a manufactory of any of the different kinds of lumber which are so plenty in this vicinity.

Machinists' Supplies and Iron.

New York, Feb. 21, 1888.

Iron—American Pig—We quote Standard Lehigh brands, $21 to $21.50 for No. 1 X Foundry, with outside brands obtainable at $20 to $20.50. No. 2 Foundry $19 to $19.50 for Standard Lehigh brands, others at $18 to $18.50, and Gray Forge from $16 to $17.

Scotch Pig—We quote Coltness $21 to 21.25; Glengarnock, $20.25 to $20.50; Gartsherrie, $20.75 to $21; Summerlee, $21 to $21.25; Eglinton, $19.25 to $19.50; Langloan, $19.50 to $20; Dalmellington, $19.50 to $20, and Clyde, $19.50 to $20.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to sell planes, see page 1.

Draftsman wanted; young man with some experience. Address B. F. Co., care Am. Machinist.

Wanted—At once, ½ dozen machinists; good pay; steady work. Clark Bros., Belmont, N. Y.

Draftsman accustomed to furnace and rolling mill work, wants position. Furnace, Am. Machinist.

Young mechanical draftsman with exp. wishes position as asst. or otherwise. A. Y., Am. Machinist.

Situation wanted by a first-class mechanical draftsman and machine designer. O. M., Am. Machinist.

Wanted—Ten first-class machinists on engine work; steady employment to good men. Ottumwa Iron Works, Ottumwa, Iowa.

Situation wanted by mechanical draftsman; 2 years' experience from technical school; wages no object. Address T. T, Am. Machinist.

Machinist wanted: One to act as foreman in a small first-class shop; none but skillful workmen need apply. Address A. B., care Am. Machinist.

A foreman pattern maker to take charge of six to eight men in a locomotive works; must be experienced in locomotive work; state previous experience and wages required. P., Am. Machinist.

Wanted—Head draftsman in machine shop, foundry and boiler works in Pennsylvania; graduate of technical school with experience preferred. Address, giving particulars, and stating salary expected, N. O. P., Am. Machinist.

Wanted—A draftsman; one who is familiar with machine tool work; must have a technical as well as a practical learning, and understand general office work; send reference; young man preferred. Address Box 86, Am. Machinist.

Wanted—A thorough machinist that has knowledge of steam machinery, to act as foreman of good manufacturing plant, in a city of 35,000; must take about $2,000 stock; state age and experience; fair salary will be paid. Box 85, Am. Machinist.

Wanted—Foundry foreman for large establishment making miscellaneous jobbing and snap flask work; a rare opportunity for a thoroughly capable man. Address with reference, and state expected salary, H. M. Allen, 44 W. 2d st., Cincinnati, Ohio.

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Wanted—By a practical machinist and iron founder who has risen from apprentice at 16 years to journeyman foreman and superintendent; practical, economical, and with good record, 37 years' old, a change after April 1, 1888. L. F. Maron, Am. Machinist.

Wanted—At the Can. Loco. Eng. Co., Ld., Kingston, Ontario, foreman pattern maker to take charge of their pattern, joiners and tender erecting shop; must be an experienced pattern maker, accustomed to locomotive work. Address, stating age, exper'nce, reference, and salary required.

Mechanic—Wanted by a thorough practical mechanic, a situation as master mechanic in a rolling mill or iron works; is a thorough practical engineer and millwright, and has the best method of rolling waste steel rail ends into hoops for cotton ties and wire rods. Box 87, Am. Machinist.

Practical man with large experience designing and constructing machines and tools for brass and iron work, good inspector, with method of keeping cost account, experience in buying and selling, desires to engage with other parties; references from present firm. Address B. W. Am. Machinist.

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Wanted—Special machinery to build; correspondence invited. Address Drawer F, Shenandoah, Pa.

Wanted—Parties having machinery specialties to build, to correspond with. Box 75, Am. Machinist.

Wanted—Partner with $5,000 or $10,000 in machine shop; best location on Pacific coast; good business man or mechanic. H. S., Am. Machinist.

Wanted—A second-hand Allen portable riveter for shell work and air compressor; must be in good order. P. O. Box 1394, Philadelphia, Pa.

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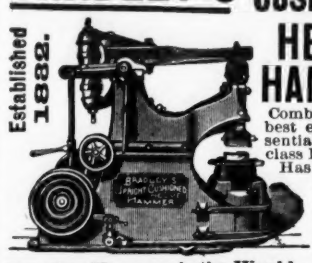

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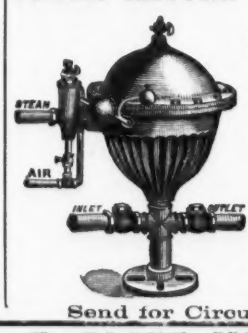

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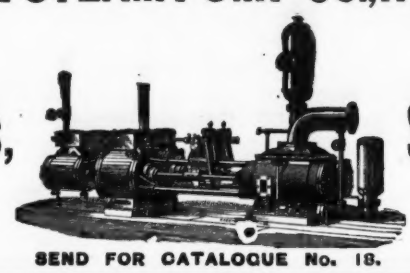

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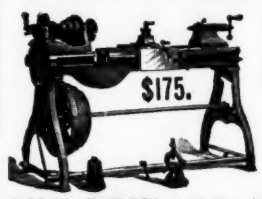

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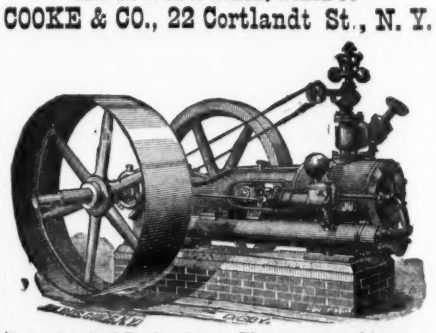

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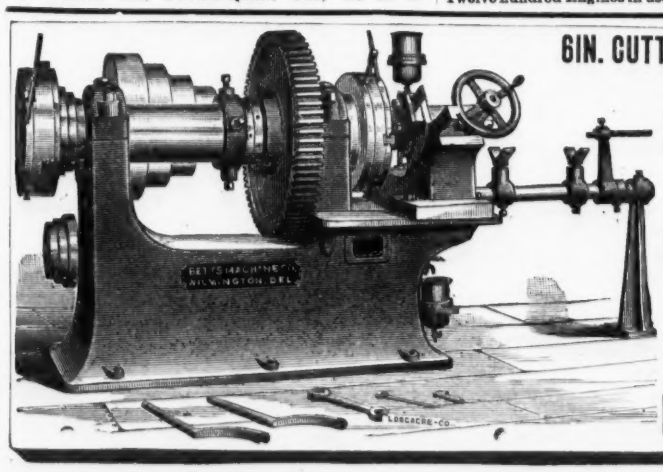

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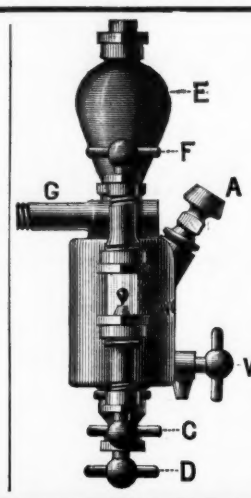

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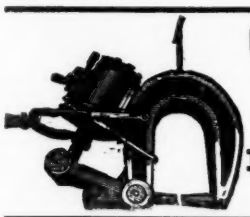

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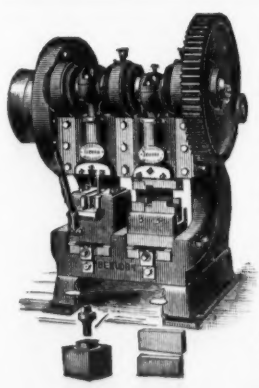

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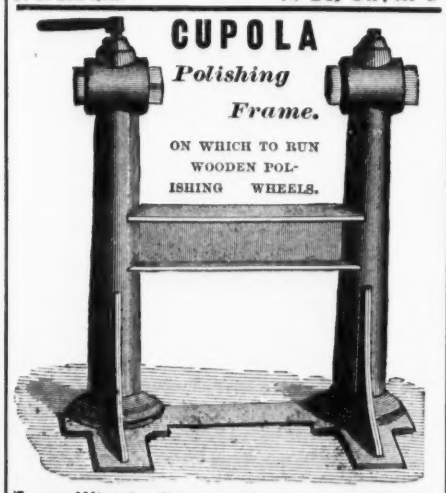

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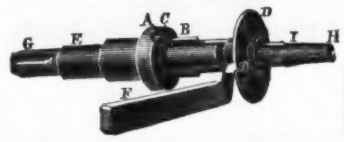

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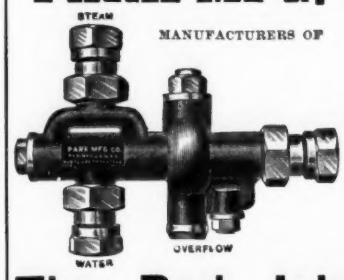

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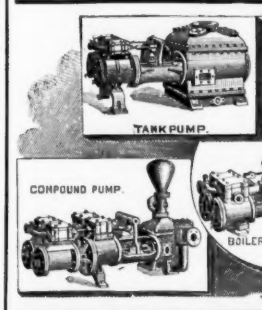

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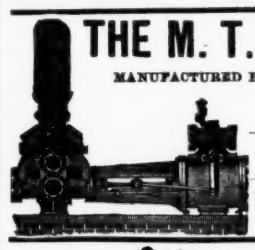

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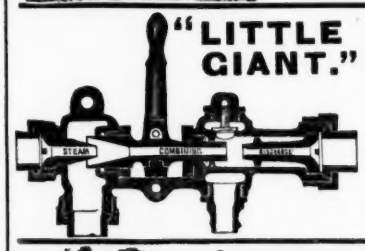

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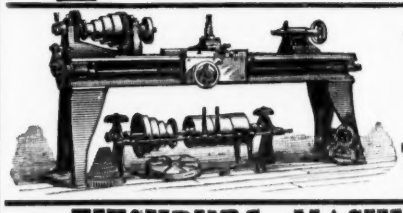

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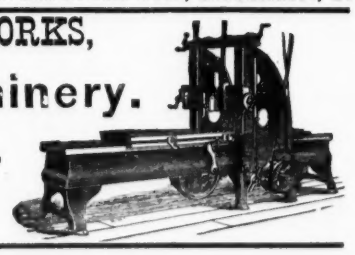

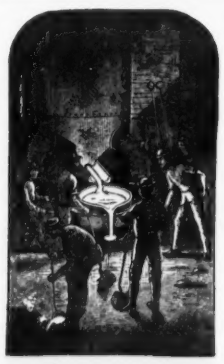

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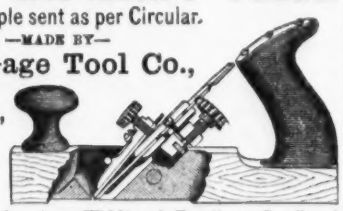

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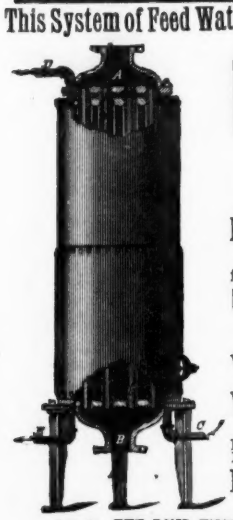

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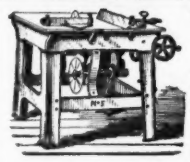

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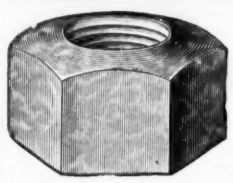

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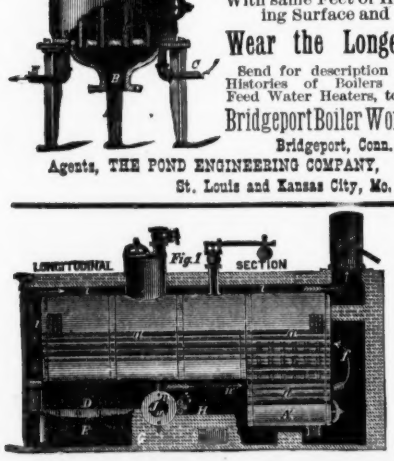

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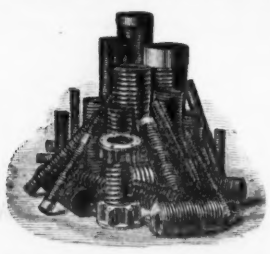

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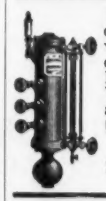

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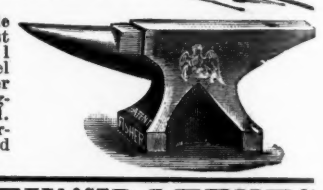

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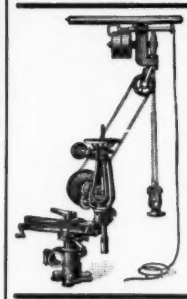

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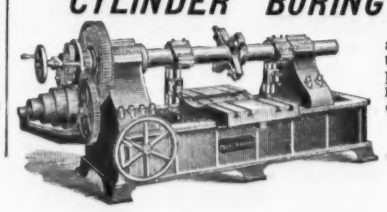

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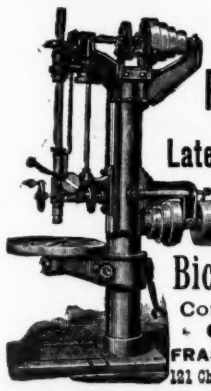

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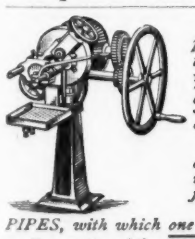

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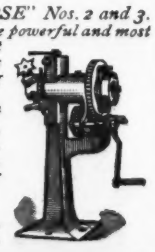

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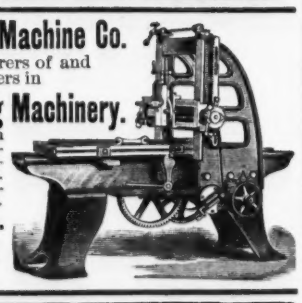

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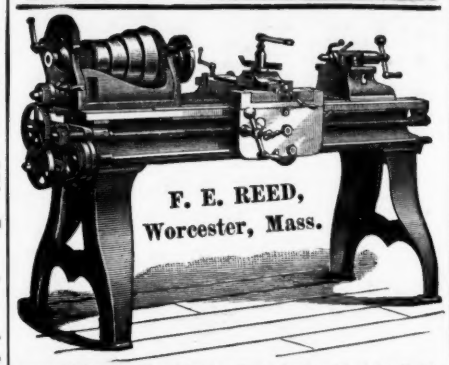

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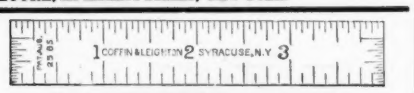

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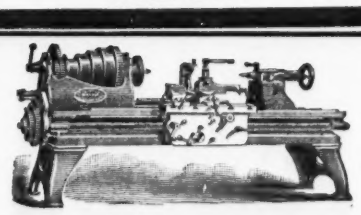

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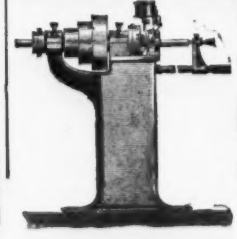

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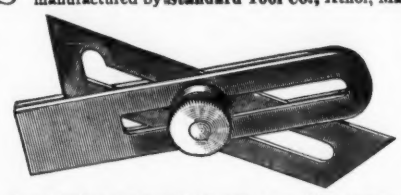

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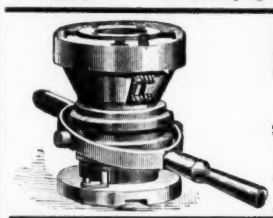

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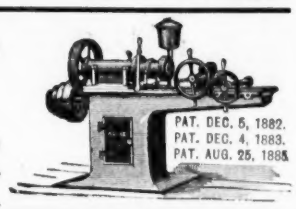

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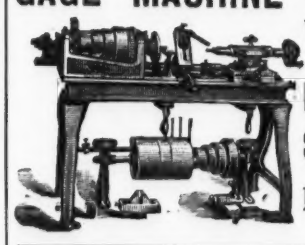

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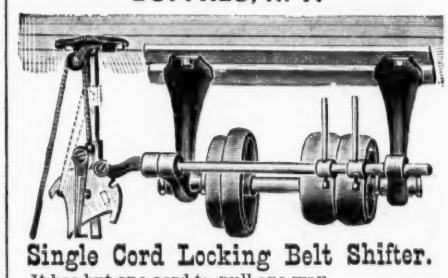

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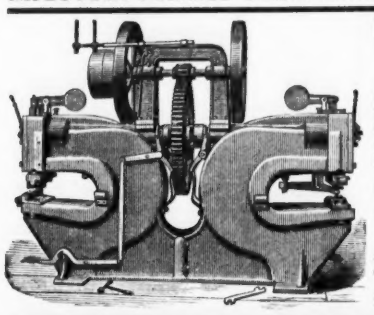

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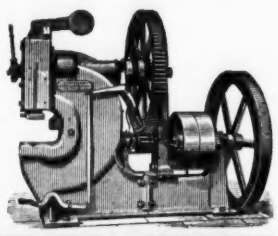

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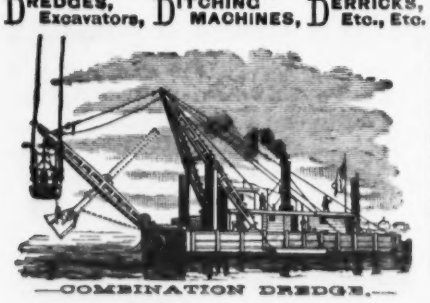

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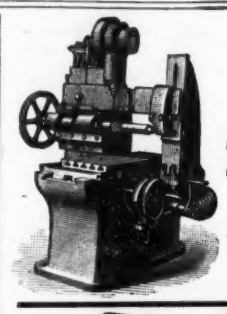

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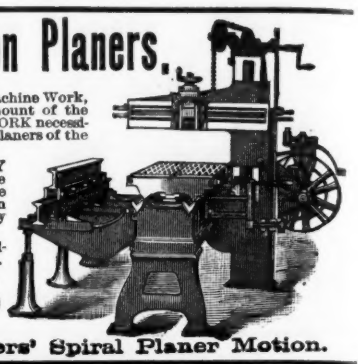

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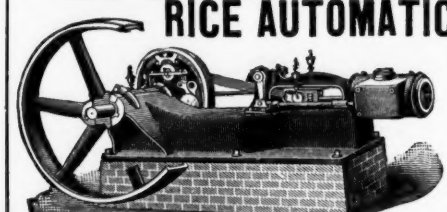

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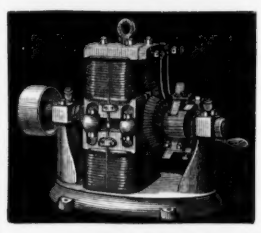

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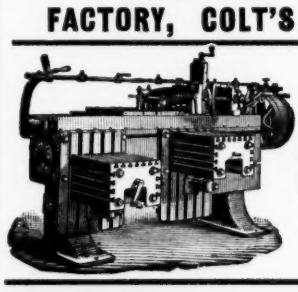

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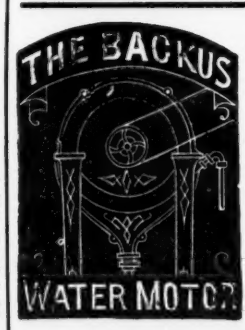

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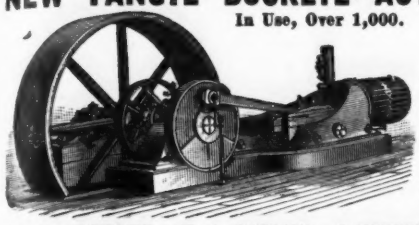

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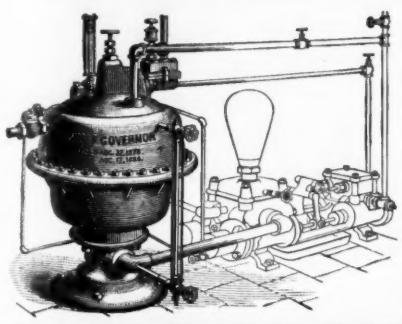

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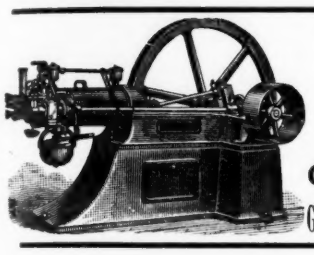

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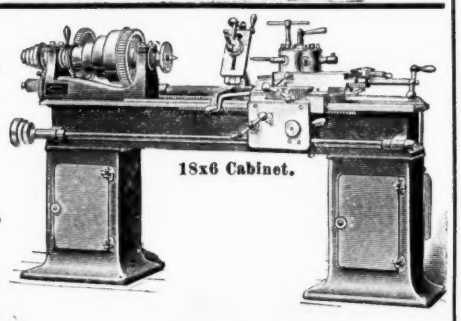

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12 in. x6 ft.	Engine Lathe,	new
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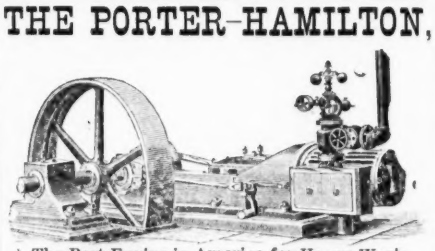

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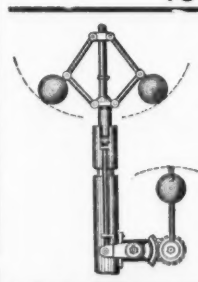

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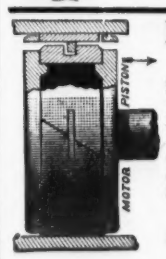

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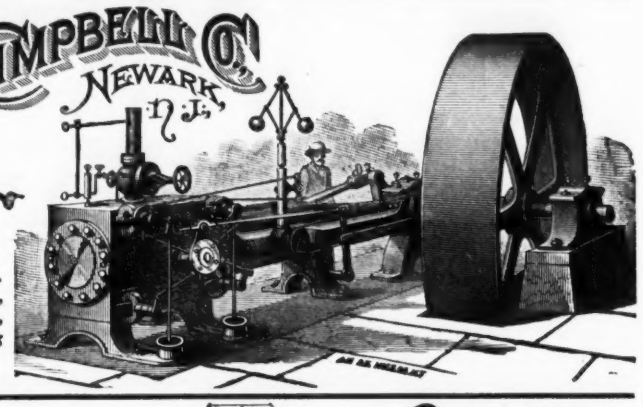

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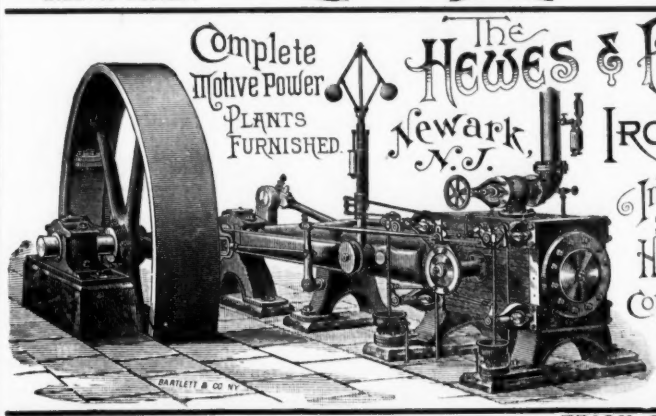

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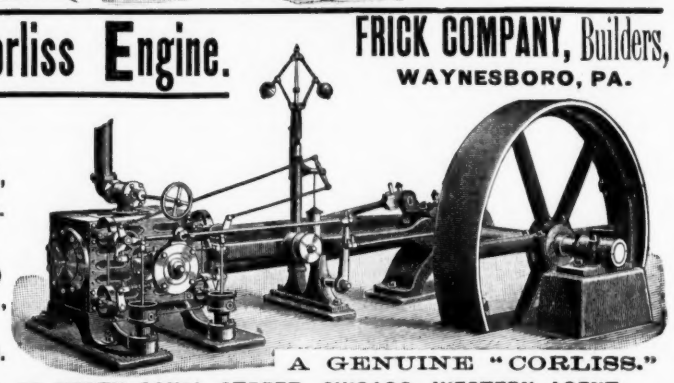

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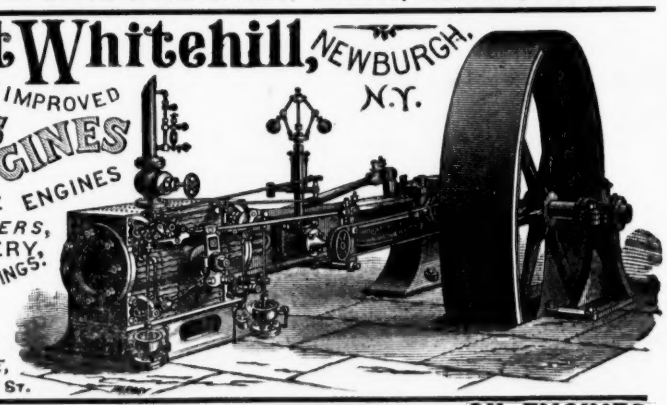

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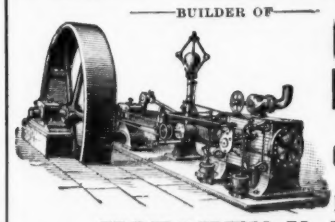

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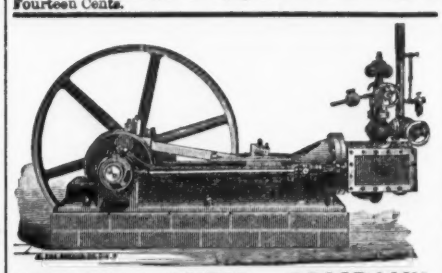

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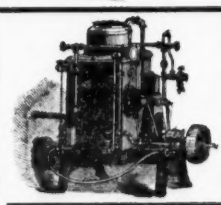

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17 "	10 " " "	" "
19 "	8 " " "	" "
23 "	10 " " "	" "
27 "	16 " " "	" "
18 "	8 " " "	Flather.
20 "	10 " " "	"
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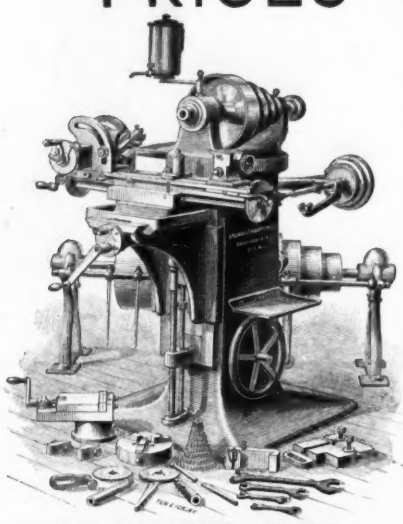

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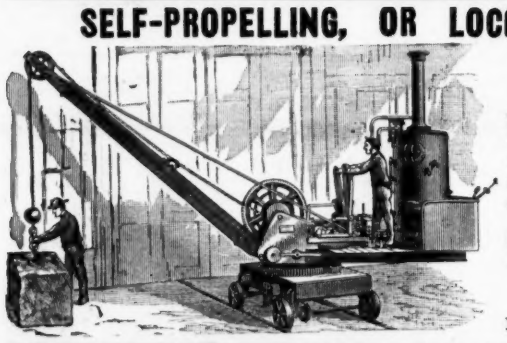

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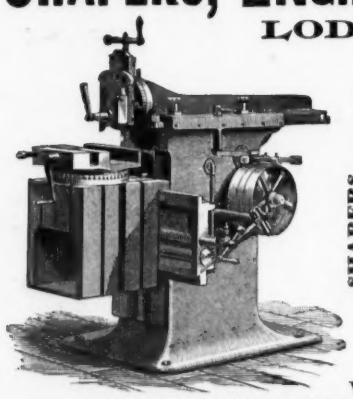

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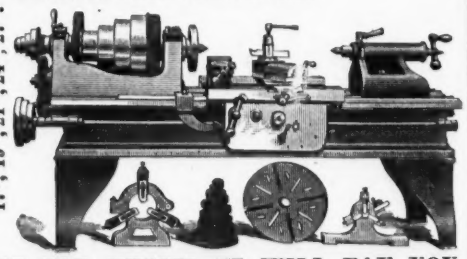

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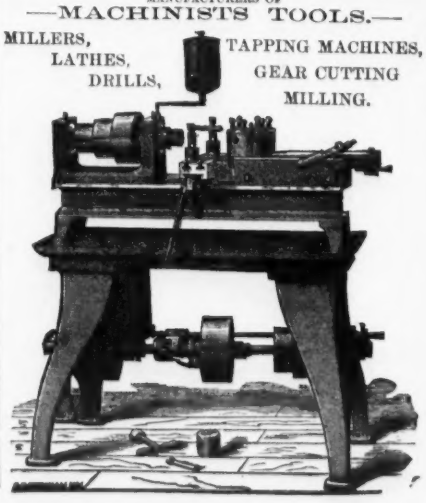

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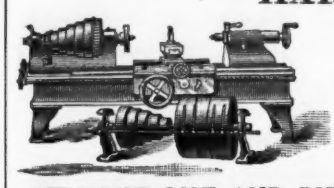

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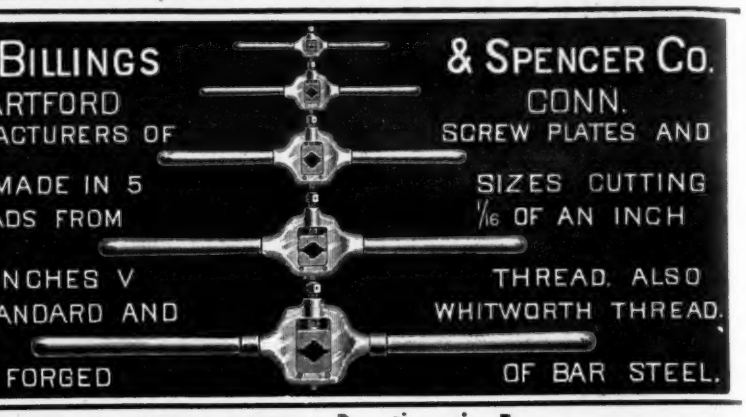

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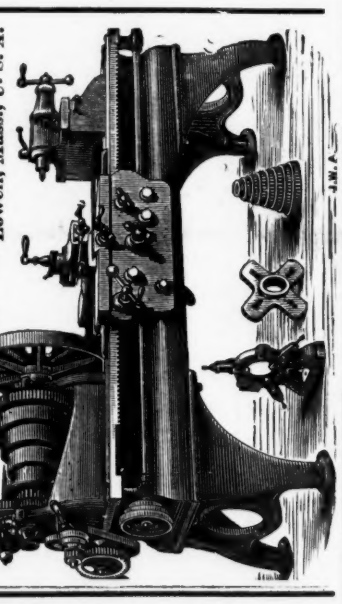

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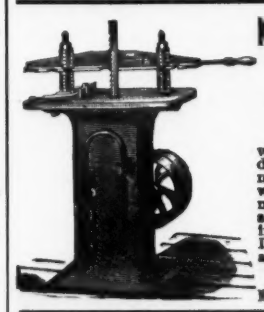

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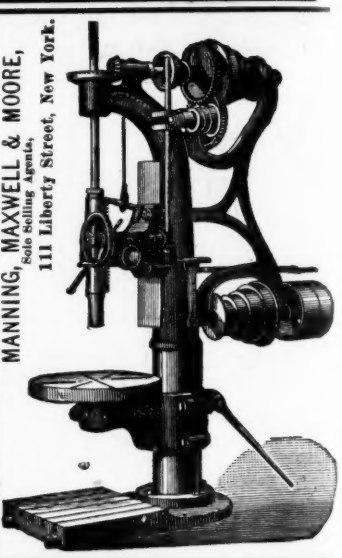

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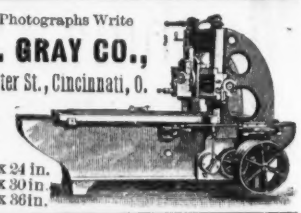

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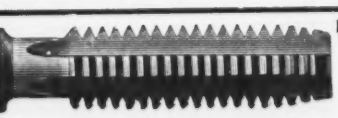

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